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ABSTRACT

This proceeding of the third WebNet conference--WebNet 98--addresses research, new developments, and experiences related to the Internet, intranets, and extranets. The 265 contributions of WebNet 98 presented in this volume consist of the full and short papers accepted for presentation at the conference from a collection of more than 600 submitted from 40 countries. Included are position papers by leading experts in the field; descriptions of ideas and products; reports on concrete applications of the Web; discussions of the impact of the Web on various aspects of life; plus considerations as to how society might adjust to the resultant changes. Major areas covered at the conference include: (1) commercial, business, professional, and community applications; (2) educational applications; (3) electronic publishing and digital libraries; (4) ergonomic, interface, and cognitive issues; (5) general Web tools and facilities; (6) personal applications and environments; (7) societal issues, including legal, standards, and international issues; and (8) Web technical facilities. (AEF)

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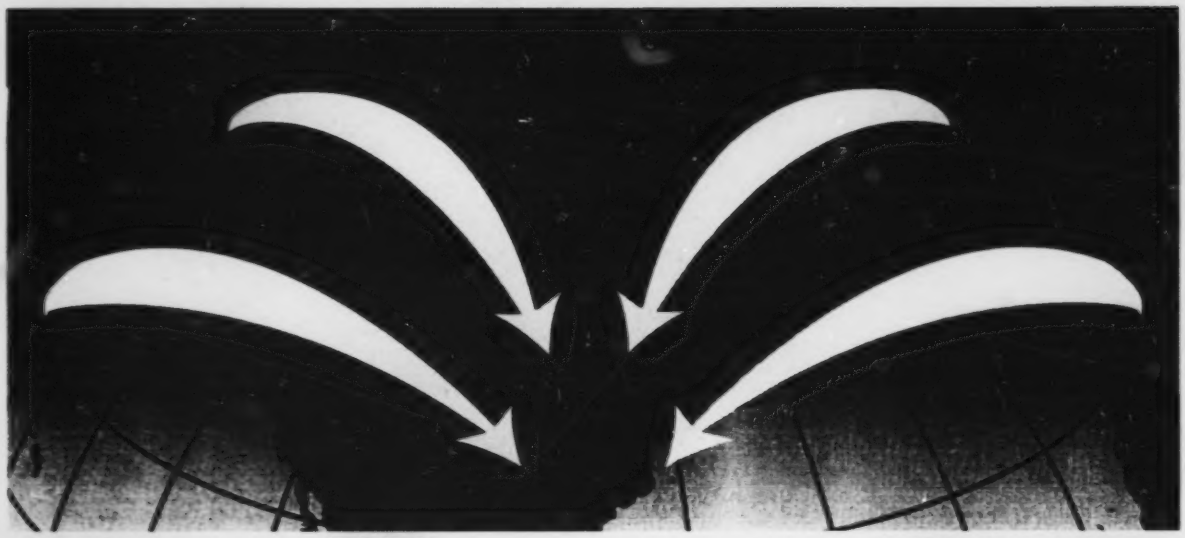

WebNet 98
WORLD CONFERENCE
of the WWW, Internet, & Intranet

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TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)"

Edited by
Hermann Maurer
Richard G. Olson

**Proceedings of WebNet 98 —
World Conference of the WWW, Internet & Intranet**

Orlando, Florida, November 7-12, 1998

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Preface

On behalf of the Program Committee and AACE, it is our pleasure to present to you the proceedings of the third WebNet conference – WebNet 98. This conference addresses research, new developments, and experience related to the Internet, Intranets, and Extranets.

The 265 contributions of WebNet 98 presented in this volume consist of the Full and Short Papers accepted for presentation at the conference from a collection of more than 600 submitted from 40 countries. All submissions were carefully reviewed by at least three members of the Program Committee and their recommendations used for selection. Borderline cases were reviewed at a special Program Committee meeting where appropriate decisions were made based on re-reviews.

The coverage of the contributions is very wide, which is one of the features that distinguishes the WebNet series of conferences from others that focus on more specific areas. Our intention has been to provide an application oriented conference - a meeting place of developers, researchers, practitioners, and users - as a forum wherein persons from disparate but related fields can meet and learn about new developments that impact their activities.

This volume contains position papers by leading experts in the field; descriptions of ideas that are on the borderline between an idea, a prototype, and products; reports on concrete applications of the Web; its impact on various aspects of life; plus considerations as to how society might adjust and react to the resultant changes.

The major areas covered at the conference and presented in this volume include:

- Commercial, Business, Professional, and Community Applications
- Educational Applications
- Electronic Publishing and Digital Libraries
- Ergonomic, Interface, and Cognitive Issues
- General Web Tools and Facilities
- Personal Applications and Environments
- Societal Issues, Including Legal, Standards, and International Issues
- Web Technical Facilities.

These general areas have been divided into fifty-six more specialized topics.

In addition to the papers included in this volume, participants in the conference also heard leading experts present Keynote and Invited lectures; participated in tutorials, workshops, small-group discussions, and poster sessions; and had a chance to see demonstrations of various items of interest. The conference was also preceded by two days of tutorials and workshops. This printed record cannot show all aspects of this highly interactive, media-rich Web meeting, but it does convey the depth and breadth of the conference.

Let us take the opportunity to urge you to plan now to **attend WebNet 99 in Hawaii Oct.30 - Nov.4.** To attend and observe the WebNet series is one of the best ways to stay current with the rapid and intriguing developments of the Web. Periodically check **http://www.aace.org/conf/webnet/** for information.

All of us realize that the Web is coming to have a major impact in international society. There is increasing confusion and concern on the part of many, in a wide variety of fields, as to what the implications and possibilities of the Web are. We all, as persons immersed in the topic, have a responsibility to explore, and clarify for others, the practical possibilities. We urge that you, and those with which you are in contact, consider these matters and reflect that thinking in your participation in WebNet 99.

In closing, we would like to thank all authors for submitting their work, and all members of the Program Committee, listed on the following page, for their cooperation and time spent reviewing submissions. Special appreciation is extended to Gary Marks (AACE), who is one of the main driving forces behind this volume as well as the WebNet series of conferences, and the AACE staff who contributed so much to the success of the conference.

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Harald Haugen, Stord/Haugesund College, Norway; Bodil Ask, Agder Research Foundation (SENTEK), Norway

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Lars Svensson & Tobias Ekenstam, University of Trollhättan Uddevalla, Sweden

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Telematic Platform for Patient Oriented Services
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Searching the World-Wide Web: Implications From Studying Different User Behavior

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Abstract: Following the recommendations of the W3C Web characterization group to characterize Web accesses and tasks, we analyze client accesses to Web Information Retrieval Systems (IRS), and in particular their queries. Instead of focusing on one server logfile, we compare accesses from groups of clients to different Web IRS. Although the analysis covers a number of client groups, the results show that clients behavior does not vary much between different groups. Clients tend to use simple queries with a small number of terms and operators regardless of user computer background or knowledge. By identifying client sessions based on some reasonable heuristics we quantify the amount of searching and browsing per session. One of the interesting findings is that increased searching corresponds to reduced network and server traffic. With more searching steps, there is less need for browsing steps, which leads to a reduction in the number of bytes transferred.

Introduction

To help users locate information on the Web, special search tools and cataloging systems were developed. We call these tools Web Information Retrieval Systems (IRS). Web IRS have evolved rapidly over the last five years, and have been used by millions who thereby had their first experience with search engines. [Borgman et al. 96] observed that "The end users who now dominate searching are using systems with exploratory interfaces, under less time pressure, and have less clear retrieval goals than do skilled search intermediaries."

As part of a larger effort to characterize WWW traffic so as to support modeling, planning and prediction, and to help scale up the Web, we seek to study Web IRS-related traffic. In the HTTP-NG activity statement they stated "It is important to understand the actual system and how it is being used before attempting to optimize it", and "The task of the first group is to characterize the kinds of tasks actually performed using HTTP, and the kinds of documents that are retrieved" [W3C 97]. In this paper we study sessions, queries, and browsing activities using five log files collected from diverse situations. We characterize queries by looking at their complexity with respect to numbers of terms and operators. We also demonstrate that sessions with searching tend to consume less network bandwidth than other sessions. We do that by first defining an algorithm to extract client sessions. Second, we analyze the sessions and show that those with more search steps are responsible for fewer transferred bytes. We define user sessions in terms of "Browsing," "Searching," and

"Next step" activities. Then we look at the most popular patterns in the identified sessions. Using regression, we discover a correlation between amount of searching in a session and the bandwidth requirement.

Related Work

[Pollock and Hockley 96] demonstrates that user background does not affect the search process or results. The authors demonstrate this through an experiment that compares naive and non-naive user searches. The authors conclude that there are misconceptions and problems with Web searching due to the design of available search tools. [Catledge and Pitkow 95] characterized browsing strategies to the World-Wide Web. The objective of the study was to understand user behavior and come up with usability suggestion for design of web pages. The data was captured using a modified version of Mosaic. Based on their analysis they used 25.5 minutes to be the time that separates two sessions. Based on our statistical analysis we found that this value is too high and we suggest 5 minutes to be the session separator.

Our approach in this paper is different in many ways from studies like those mentioned above. First, our data has been collected from a variety of user groups in natural environments, not experimental situations. Second, we do not evaluate the different search systems, however, we do study user queries to see if they utilize available functionality. Third, we look at the usage of search engines and compare it to browsing. Fourth, we demonstrate the value of searching by observing that sessions with more searching frequently have less browsing, so there are fewer bytes transferred over the network.

Workloads Studied

[Tab. 1] describes the workloads used in this study, showing dates of log file collection and number of accesses. The workloads represent different groups of users with different ages and backgrounds so we can contrast those groups and generalize our results whenever feasible. For a detailed description of the workloads used please refer to [Abdulla et al. 97].

Workload	Period	Number of (K) accesses
Korea	9/2/95-9/26/95	1682
Library (VT)	9/19/96-11/20/96	128
CS (VT)	10/9/96-11/10/96	92
AUB (High School)	10/21/96-10/22/96	19
AOL	11/96 (1 hour)	897

Table 1: Workloads used in this study

Accesses to Web IRS

We define accesses to Web IRS to include all accesses to Web IRS such as Lycos, Infoseek and to cataloging systems such as Yahoo. For comparison, we count the number of accesses that do not contain a search command and compare it to the total number of accesses in the workload. This way we compare total accesses to Web IRS to the total accesses to other servers. However when we analyze queries we only look at accesses with an explicit query command.

[Tab. 2] compares accesses to search servers to the total number of accesses in each workload. We notice that in all workloads the percentage of accesses to Web IRS is no more than 20%. This is reasonable since the search activity is always followed by browsing activity to explore the returned URLs and how relevant they are to the search. However, we also notice that in the high school case the percentage is very high compared to the

others; this is because the students were instructed to use the Web to find information. Interestingly the library workload was second highest, which reflects a key service of libraries, namely locating information. We call this the task effect; because the students were assigned a certain task and library users often focus on search for information.

Workload	Accesses to Web IRS	% (from total accesses)
Korea	67756	4
Library (VT)	15408	12
CS (VT)	5780	6
AUB	3839	20
AOL	78026	9

Table 2: Accesses to Web IRS and their percentages

The Korea workload has the lowest percentage. One reason could be that the data was collected a year earlier and Web users were not very well informed about Web IRS or because all search engines are located outside Korea, hence users avoid searching due to slow network connections. We expected that the CS workload ratio would be higher than other workloads in using Web IRS but local CS clients search the Web during only 6% of their accesses. This ratio is low compared to all other workloads except Korea. By examining the log file further we noticed that accesses from the CS clients are mostly to servers inside the department and those accesses are mostly repeated accesses to pages they are developing.

Workload	Clients (total)	Clients performing searches	% of searches
Korea	2136	929	43
Library (VT)	348	203	58
CS (VT)	36	21	60
AUB	79	79	100

Table 3: Total number of clients and cients which accessed a Web IRS

[Tab. 3] lists the total number of clients in each workload and compares it with the number of clients who have accessed a Web IRS. We see that the ratio differs for different workloads. All clients in the high school have accessed Web IRS because they were supervised by teachers who knew about the available search tools and how to use them and who instructed the students regarding how to search.

The results in tables 2 and 3 confirm that Web users do use Web IRS to locate information. However the degree of computer knowledge does not appear to predict the percentage of accesses that are queries, for our workloads. This is consistent with the findings reported in [Pollock and Hockley 96]. However, the task effect is very clear in two cases, the library and the high school (AUB).

Queries

Workload	Number of queries	% of accesses
Korea	16845	22
Library (VT)	2515	16
CS (VT)	1503	26
AUB	619	16
AOL	5342	7

Table 4: Number and percentage of accesses that contain queries

In this section we study queries submitted by users and also attempt to identify inefficiencies. We start by counting how many accesses to the Web IRS are queries and compare that with the total number of accesses to the Web IRS. [Tab. 4] shows the number of accesses to Web IRS in each workload which of those contains a query. The rest of the accesses to Web IRS may be to load the home page of the Web IRS, to read help pages about how to do the search, or to access inline images. The CS (VT) workload has the highest percentage. A higher percentage in this table means that the users in this workload accessed the Web IRS more to submit queries and less to take other actions.

Query Complexity

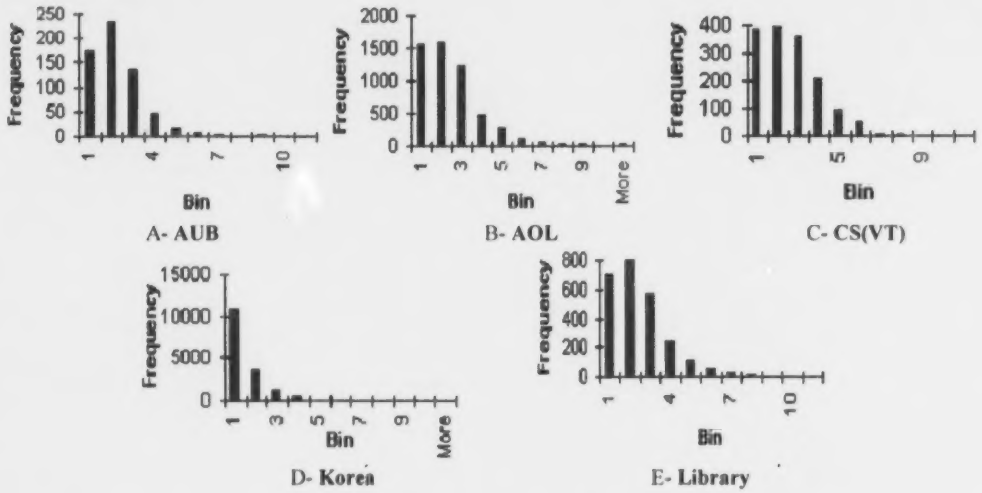

Figure 1: Number of terms/query

We measure query complexity by counting the number of terms and number of operators used in queries. We refer to each word in the query as a term; and each ``and," "or," "not" or any proximity operator as operators. [Fig. 1] shows the distribution of number of terms in the issued queries for each workload. From the figures we can see that users often use more than one term in their queries; in fact for all workloads except Korea (where perhaps search skills most need improvement) two terms per query is the most popular situation. When using more terms users may be trying to be specific to get more relevant results. In some queries the number of terms exceeded 5. In a ranked system this is beneficial in spite of the large number of partial matches if good terms are chosen, due to statistical correlation, since users can define a threshold when they will stop looking at retrieved documents, or can just examine the K best documents (e.g., for k=20).

We studied the distribution of number of Boolean operators/query for each workload. In all workloads most of the queries had no operators, as would be expected for one-term queries, or queries to a "natural language" Web IRS. (Note: This is the case for the Web IRS that we have examined; all have a ranking feature, or allow Boolean queries if special syntax roles are followed.) We noticed that the majority were simple natural language queries. Clients rarely use the Boolean operators or the advanced features of the Web IRS.

Analyzing Clients' Sessions

User and client sessions contain important information. The problem of extracting sessions is very hard and needs more research. In our study we used heuristics to identify sessions and then studied the correlation of number of searches and the total number of bytes transferred. We also classified the behavior of clients in

terms of three steps: "browse" or "b", "search" or "s", and "next set of results" or "n". Here "search" or "s" is defined to describe accesses with an explicit query; "next" or "n" is for accesses with "n" in the query field. Any other action is considered to be a "Browse" or "b".

The first step in processing was to extract the interactions for each client from the log file that contains all accesses generated from that client. The next step was to identify session boundaries in each client's log file using the algorithm of [Fig. 2]. By examining the log files we selected 300 seconds as a safe threshold to indicate a session break. We scanned the client logs generating a sequence of interactions for each identified session. For example a certain client might have 10 sessions in its log file. Each session is represented as a sequence of "b", "s", and "n" codes. The most frequent common sequence, which appear in all workloads, in effect yield a partial grammar of client sessions, empirically based; for the details please see [Abdulla et al. 97].

```
separate accesses for each client into a separate file;
For each client do
  {
    if (accessed path is related to the previous accessed path)
       {this is the same session}
    else {
          if (time between accesses< 300 seconds)
            {This is the same session}
          else {different session}
        }
  }
```

Figure 2: Algorithm to define a client session

We explore the correlation between searching steps and the number of bytes transferred. We defined RSNB=(s+n)/b, which is the ratio of search and next steps over the browsing steps. We conjectured that if we have more search-related steps then the number of bytes transferred for the session should be less. We used regression and correlation to determine the relation between the above ratio as well as counts of b, s, and n codes, and the number of bytes transferred.

Access pattern	Korea (%)	Library (VT)(%)	CS (VT)(%)	AUB(%)
B	85.25	93.66	89.78	85.25
BsB	5.63	3.86	4.02	5.63
BsBsB	2.00	0.62	1.72	2.00
BsBsBsB	1.15	0.20	0.70	1.15
BsBnB	0.51	0.05	0.14	0.51
BnB	0.46	0.93	0.27	0.46
BsBsBsBsB	0.35	0.07	0.41	0.35
BsBnBnB	0.30	0.01	0.00	0.00
BnBnB	0.15	0.08	0.15	0.15
BnBnBnB	0.15	0.03	0.00	0.00

Table 5: Percentage of the most frequently repeated string patterns in all workloads.

The correlation analysis for four of the workloads (Korea, AUB, CS (VT), Library(VT)) showed that there is a negative correlation between the ratio (s+n)/b when compared with the number of bytes transferred. The regression results for all four workloads are highly significant. This negative correlation suggests that a higher searching and browsing ratio corresponds to fewer total bytes transferred. The regression analysis for number of bytes transferred as a function of b, s, and n counts revealed that the coefficients of the variable b are significant in all workloads. The coefficients of the variable s are only significant in the library and AUB

workloads. The coefficients of the variable n are only significant in the Korea and library workloads. It appears that b is the most important variable that determines the total bytes transferred.

To simplify the analysis of access patterns, we replace a sequence of b's with "B". [Tab. 5] shows the top 10 popular access patterns for the workloads. The most popular access pattern in all sessions is the sequence with b steps only and it is represented by B in the table. This pattern occurs in over 85% of all sessions which suggests that users are browsing most of the time. This is consistent with our previous conclusions. This high percentage suggests how much bandwidth we might save if we enable users to search more and browse less when they look for specific information, such as by having more effective retrieval methods. It is interesting to note that the first three access patterns not only are common between all workloads but also that they have very close percentages. The second popular access pattern is "BsB", which implies that the client has done one search after browsing and ended the session with browsing. Access pattern "BnB" is interesting because we had an n appearing without a search. By examining the log file we found out that this can occur if the client uses the catalogue in some Web IRS to get to a certain category, then presses "next screen" to get more hits.

Discussion

Although clients use Web IRS to locate information , they rarely use the special additional features available through the Web IRS interface. It appears that users prefer to issue queries with one term and without Boolean operators. These findings imply that the Web is either dominated by inexperienced searchers or Web IRS interfaces are not intuitive enough. Future work should identify why users rarely invoke advanced Web IRS features during searches which can be due to lack of training or the interface is not clear. By looking at the access patterns in the sessions we found that the most frequent repeated pattern is browsing only. By using regression and correlation analysis we found when a session involves more searching, then less network and server bandwidth is used. This is another reason to encourage use of searching.

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MEDIT: a Distance Education Prototype for Teaching and Learning

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Abstract: MEDIT is a Web-based environment for various pedagogical issues. It aims at offering complementary support to traditional practices. Our approach distinguishes a set of virtual working spaces and provides the appropriate services for each of them. In addition to a generic hypermedia authoring system, we implemented advanced tools for multiple view representation of a course, creation and maintenance of private workspaces, the aim being to stimulate information exchange, interaction, and collaborative work among the actors involved. The project is currently under evaluation through three undergraduate courses in the Swiss Federal Institute of Technology.

1. Introduction

The last decade is witness of the widespread use of NICT in many different applications such as public administration, medicine, education, edition and press, social services, commerce, etc. Education is one of the fields, which can take advantage of bringing down barriers of time and space with the use of WWW and Internet. A new training method, the Web Based Training (WBT) has raised the interest of private industries who see in it an economic and effective way to train their employees as well as of educational organizations. WBT [Kilby 1998] uses the techniques developed for the CBT (Computer Based Training) coupled with telecommunications networks and with WWW technology (HTML, HTTP, TCP/IP) and adds to CBT's advantages (Multimedia capability, personalized learning pace) the characteristics of the Web such as platform independence, integration of infinite information sources, discussion possibility, easy delivering of training and easy updating of data. From the point of view of the effectiveness of education, what makes the difference between a simple distribution of information and a real class or lesson, is interaction; interaction with teachers, with other students, practical problems, and real examples make learners more motivated and productive in the task they do. WBT offers a priori all the services that make possible the realization of interaction. Numerous projects currently deal with the development of computer-aided learning and tutoring environments to address a variety of pedagogical issues. However, the majority of them focus on the replacement of the role of a tutor with the features offered, without taking care about retraining teachers and students and changing their attitude and their ability to interact effectively with technology. In this context we present the prototype of the environment MEDIT, taking place in the Swiss Federal Institute of Technology (Jan. '97-Dec. '98) that aims at developing a Web-based environment for a variety of pedagogical services [Abou Khaled 1997]. The project intends to offer a valid support to traditional practices in education allowing instructors to decide which level of integration of NICT to use within the traditional course, from an information board for the class, to an instructional medium. The environment provides all the course component a learner is intended to experience in a course [Collis 1997]. To let teachers and students cooperate and easily work with Multimedia documents, specific Hypermedia Authoring Systems are implemented for the needs of the project. The originality of our approach lays on the use of highly structured documents that allows reusing of pedagogical materials in multiple purposes, as well as in an efficient management of all document classes. The environment offers adapted tools for different services; a HAS allows teachers, or administrators, to manage a virtual space for the creation of multiple courses, with rights of access for instructors, assistants and students. When a space has been assigned for a course, the professor can construct his/her own architecture and choose the services he/she wants to offer, via an efficient authoring system. Another service allows to provide four different views of the course: two classical views (by Chapter and by Session), a new one, namely the Semantic view for which the author is the teacher, but also a fourth view Private view completely managed by the students. The paper is organized as follows. [Multidisciplinary approach] highlights the development of a Web based pedagogical environment [Abou Khaled 1998], approaching the problem from a point of view

of involved know-how and sciences: pedagogy of distance education, HAS and HCI research axis. [MEDIT] discusses in detail the features of automatic creation of a virtual course space, and one of the important pedagogical issues addressed in MEDIT system, the course customization and views. Finally, [Conclusion and Future Works] concludes the paper with an argue of the implication of the distance education system we implemented, and future work plans.

2. Multidisciplinary approach

WBT is a science involving several research axes deeply linked to the very nature of the system; we group here the disciplines in three main ones: the first is dealing with the analysis of different components of a course to use them in a distance education environment, and to exploit and enrich all the possibilities of NICT with respect to the real users' needs; we will call this science Pedagogy of distance education. The second science involved is the HAS study, which let create a system allowing users to easily accomplish their tasks (teach and learn) overcoming technological problems. The third science involved is HCI (Human Computer interaction), based on the analysis of user's requirements and judgments which aims at improving and certifying the qualities of the interactive system.

2.1 Pedagogical issues in distance education

The aim of this science is to provide high quality education using NICT; this necessarily involves a retraining of students and teachers. Learners have to become active and have to be actively engaged in creating personal knowledge, changing the degree of interaction and depth of learning. They should be guided in changing their attitude and skills as to became self-directed and self-motivated. On the other side, teachers have to be the intermediary between students and available resources, create new teaching applications and organize instructional materials [Parker 1997]. Traditionally a course is characterized by the following components [Collis 1997]: course content, lectures/presentation, group discussions, learning events (experiments, visits, research etc.), private communication with instructors and classmates, self-study (reading, simulations, exercises), individual/group projects, testing (supervised exercises, exams).
The difficult purpose of Pedagogy in distance education is to discover new pedagogical issues for the course components, to enrich traditional learning. Our attempt in this sense has led to build and design new formative tools taking advantage of current technology. One examples among these issues is the possibility to create new views to access to the course content: by Chapters (traditional, linear access), by Session (chronological access), by Concepts (semantic, transversal access); the use of the combined views allows a great flexibility of presentation of information with respect to the users' needs.
Another feature is the possibility to create a Private working space for students in which they are free to create their own information repository organized and structured as it's most suitable for the individual learning techniques. Services will be detailed later in the paper [MEDIT], as they are realized in the MEDIT prototype.

2.2 Usability issues: Human Computer interaction

HCI is a discipline concerned with the design, evaluation and implementation of interactive computing system for human use [Preece 1994]. The aim of HCI studies is to develop criteria to improve utility, efficiency, effectiveness, usability and safety of the system. In other terms it aims at improving the qualities of the computing system, which are observed and measured through the User Interface. The design process of an interactive system has to be user-center, that is, it has to involve real users in all the phases of development and it has to be highly iterative [Preece 1994]. To be effective, HCI techniques have to follow guidelines and rules both in Design and in Evaluation [Schneiderman 1998]. The hart of the matter is to realize objective criteria on which it's possible to build guidelines and evaluation techniques. In this context it's being developed an international standard, namely the ISO 9241: Ergonomic requirements for office work with visual display terminals. Several studies have been conducted to realize reliable tools to develop and test the interactive systems. In the development of our educational environment we are concentrating on the aspects of evaluation which plays an important role in software development aiming at determining

whether the user's needs are met, and assessing the system suitability for the task. A lot of evaluation techniques have been developed, both oriented in the employment of real users or of experts, and there are arguments that distinguish them [Oppermann 1997]. After a study of the state of the art in this field, we choose to use the ISOMETRICS evaluation questionnaire [Willumeit 1996] developed for formative evaluation of software at the Psychology University of Onesbrück. The questionnaire is based on ISO 9241/10 standard, is developed on experts' as well as on users' opinion and it foresees the involvement of real users (Subjective evaluation).

2.3 Technical issues: Hypermedia Authoring Systems

At present the cost of developing and producing large hypermedia information systems is very high and the process is time consuming. Authoring takes the major part in the development process. The Hypermedia Authoring System (HAS) is an assistance environment intended to help authors in the production of various Multimedia applications. It has to provide a user-friendly interface, involve most adequate tools for text and images processing, and automates most of the production tasks [Abou Khaled 1997][Lowe 1996].
In MEDIT project we created a HAS allowing instructors to produce and organize locally or remotely their courses, supporting collaborative work between different users. MEDIT offers possibilities to organize and structure pre-existing information into sets of WWW pages; it permits also to design pages for readability and user-friendliness with hypertext links, content definition tags, and page layout tags. Finally it provides possibilities to create graphical and text-based navigational tools, banners, and widgets which improve the attractiveness and usability of the course site.

3. MEDIT

MEDIT is an aiding environment allowing the management and the distribution of an on-line interactive course. MEDIT's purpose is to create an environment for tele-teaching and tele-learning, even if actually it can be considered to be a complementary tool for traditional courses. The prototype is being developed for the Fluid Mechanic course taught in the Mechanical Engineering at the EPFL, but developed authoring tools and the new pedagogical issues can be re-used in any educational context.
MEDIT provide a virtual course space model which provides different services (those required in a tutoring and learning environment) for different category of actors (teachers, students and administrators). Our approach for the virtual course space model was based on discussions with experts and users involved in the pedagogical domain (instructors, students, pedagogues, computer scientists, etc.).
We have distinguished a set of course-related activities, the idea being that each of them is often associated with different actors and/or services and, therefore, different tools are needed. This partition was based on the concept of virtual course spaces. The proper specification of the above concepts and their relationships was a prerequisite for the implementation of the system. Every workspace deals with specific teaching services and offers ``tailored" tools. A working space can be viewed as an instantiation of the teaching environment (with its own document classes and tools) to one's specific teaching context or needs. Each space is further divided in different sub-spaces [Abou Khaled 1997].
MEDIT offer a specific HAS for each users, in order to let them easily accomplish their tasks. Teachers and assistants have mainly the task to choose spaces that are interesting for him, as well as to create and distribute course content and exercises, dialog with students, supervise the exercises. Students have to access the course, to learn, to make researches, to self-test, to create their own documents, to be evaluated and to discuss with teachers and classmates. Administrators have to manage the accesses to the space with multiple course and the rights of access for instructors and learners in each course. The majority of existing approaches in web-based tutoring views the course as an indivisible entity, and doesn't allow teachers to have a wide choice of services or a personal configuration of the course. On the contrary, our environment allows instructors to select the spaces they desire for the course and the corresponding virtual course environment is generated automatically (this incorporates on-the-fly creation and compilation of the associated software classes) [Fig. 1].

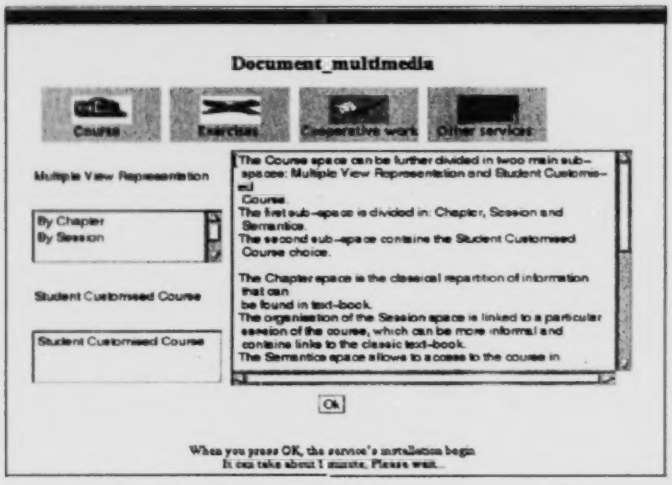
Document_multimedia
Course
Exercises
Cooperative work
Other services
Multiple View Representation
By Chapter
By Session
Student Customised Course
Student Customised Course
The Course space can be further divided in twoo main sub-space: Multiple View Representation and Student Customised Course.
The first sub-space is divided in: Chapter, Session and Semantics.
The second sub-space containe the Student Customised Course choice.
The Chapter space is the classical repartition of information that can be found in text-book.
The organisation of the Session space is linked to a particular session of the course, which can be more informal and containe links to the classic text-book.
The Semantics space allowe to access to the course in
Ok
When you press OK, the service's installation begin
It can take about 1 minute. Please wait...

Figure 1: The Course Spaces.

3.1 Multiple course views

MEDIT environment has been designed to implement advanced pedagogical issues that stimulate information exchange, interaction, and collaborative work between actors. It offers to teacher the possibility to reuse the basic information contents in order to build several views with different ways of access. The first view is by Chapter (traditional view with sequential access), allowing easy updating of course content; the second is the Session view with chronological access, and third is the Semantic view with a transversal access, that we will explain here in detail. Semantic view allows readers to select what and how they want to learn, according to their specific needs (for example, the Semantic view of a course could be used as an aiding tool to solve exercises).

Fig. 2: Semantic view in tree format

To create the Semantic view the teacher has first to conceive his/her view of the course structuring it in a tree-like course representation, based on his/her conceptual view of the subjects. MEDIT offers an easy-to-use tool to support this task [Fig. 2]. Every leaf of the tree corresponds to a course concept or options. Having finished with this task, the teacher has just to click on a button and the system will generate a set of HTML files corresponding to the tree created. By selecting such a file, he/she can then launch an editing tool and use existing views (by Chapter or Session) and external information to edit it as he/she prefers (note that in each such file there is information about the corresponding path in the tree). The students may also access the Semantic view of a course through the interface shown in the left window of [Fig. 3] (the choices appear in this interface are related to the tree constructed by the teacher and are updated

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automatically whenever the teacher modifies the tree). The right window of [Fig. 3] corresponds to what the student has selected.

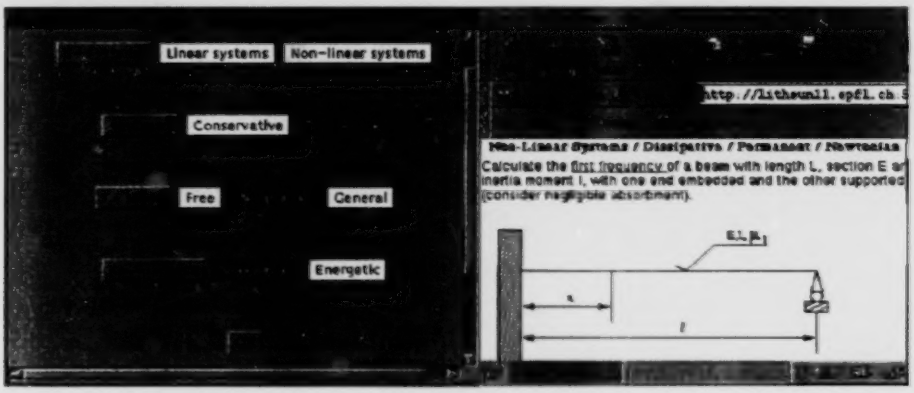

Fig. 3: Interface to access to Semantic view.

In MEDIT, students are viewed as active actors, i.e., they are not only consumers of information but, on the contrary, they are able to enrich the course through questions, notes and discussions, as well as by generating a customized version of the course. Personalized course gives to students an active role and improves their critical attitude. In this context, MEDIT reserves a Private space for each student registered for the course. The space remains his property during the semester. The management of the space is totally autonomous for each student. Features involved here are the easy creation, editing and deletion of the space and its components, access protection capabilities, and attachment of annotations and external existing documents (according to different views, after searching the Web, etc.).

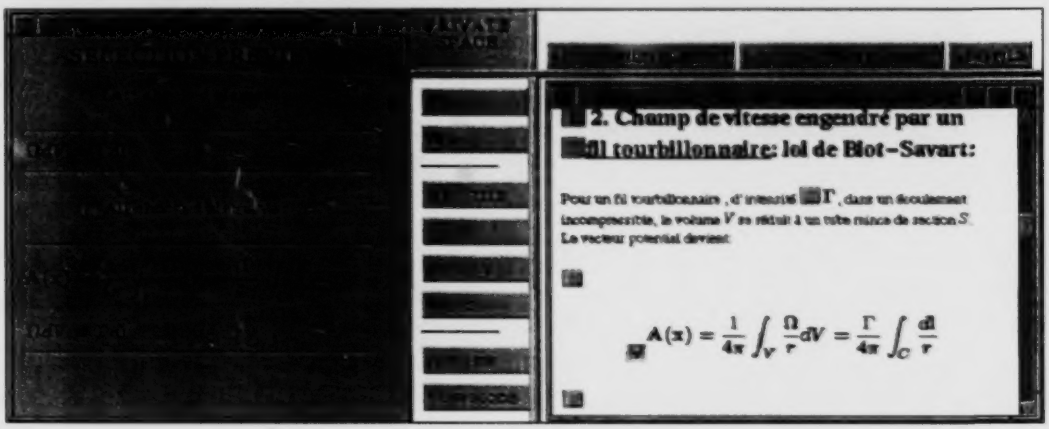
2. Champ de vitesse engendré par un
fil tourbillonnaire: loi de Biot-Savart:
$\mathbf{A}(\mathbf{x}) = \frac{1}{4\pi}\int_V \frac{\Omega}{r}dV = \frac{\Gamma}{4\pi}\int_C \frac{d\mathbf{l}}{r}$

Fig. 4: Creating a private workspace.

In the example shown in [Fig. 4], a student can browse the course documents both by chapter and session. Having selected a link, the corresponding file appears in [Fig. 4 right window]. This file is highly segmented according to a predefined set of HTML tags (the buttons shown are inserted in the existing document on the fly). Finally, the student selects the segments he/she is interested in, and can preview the file he/she has been working so far in the window appearing in the left part of the [Fig. 4]. The Private space makes the student responsible for the content of his/her course and may improve the quality of learning according to their preferred way of learning (namely active, reflective, visual, verbal, and intuitive learners [Felder 1996]).

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4. Conclusion and future works

In this paper we described the functionalities, the services, and the new pedagogical contribution of a Multimedia environment for teaching and learning on the Web: MEDIT. The system foresees and autonomous and customized organization of virtual working spaces based on user's needs. We discussed the main features of the different views of the course and of the management system of the course space. The system is currently under evaluation through three undergraduate courses (Fluid Mechanics, Vibratory Mechanics in EFPL and Database in University of Geneva) with the participation of 6 teachers (2 professors and 4 assistants) and about 100 students (20, 30 and 70 in the above courses, respectively). A system introduction (less than an hour for students and about three hours for teachers) were sufficient to get the users acquainted with it. A member of our development group supervised and assisted the users during their first try. The feedback we have received so far was very positive. Teachers were satisfied of the functionalities of the authoring environment and the easiness of its use (locally or remotely), and appreciated the fact that they can still use their preferred editors to create the required course documents, while students liked the idea of having their own Private work spaces. Both teachers and students liked the ideas of course decomposition and multiple views. The system is now being evaluated with HCI evaluation tools (ISOMETRICS) on a sample of users; feedback are collected an analyzed in order to improve the usability of the system.
Future works on functionalities presented in this paper include tracking of the student acts during the creation and maintenance of their private workspaces to extract valuable information about their profiles, interests, and learning attitudes. This information will aid teachers to re-evaluate their course conception, design of exercises and projects, and in general, their course environments.

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THE INTERACTIVE, VIRTUAL MANAGEMENT INFORMATION SYSTEMS (MIS) CLASSROOM: CREATING AN ACTIVE LEARNING ENVIRONMENT ON THE INTERNET

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ABSTRACT: This proposal describes the methods I am using to try to create an active learning environment within an Internet-based course. The introductory Management Information Systems (MIS) course is an elective that has become increasingly popular with our junior and senior Business majors. The main objective of this class is to provide an overview of the field of information systems and also to strengthen some of the computer skills developed in earlier, required classes. This spring (Spring '98) I am teaching one section of the course as a partially Internet-based class. The challenge is to apply active learning strategies and other effective classroom practices to the virtual classroom. Course materials, which are posted on the World Wide Web (WWW), are designed to be interactive. We use E-mail extensively to promote discussion, participation and feedback. Students conduct Webquests to facilitate individual assignments and a cooperative group assignment. They then create their own Web pages to present the results of the Webquest to the rest of the class. It is too early to evaluate the effectiveness of these methods. However, in the first test, students in this section performed slightly better than students from another section taught in a conventional classroom setting. By making use of widely available software tools, the teaching methods I have developed are readily transferable.

LITERATURE REVIEW

Research from learning theorists demonstrates that the "empty vessel" approach to learning is simply not very effective. This approach views students as empty vessels to be filled with knowledge by passively listening to those founts of wisdom, the instructors. Meyers and Jones [Meyers & Jones1993] cite studies that found that students retain only 20% of the information provided during the last 10 minutes of a lecture. They also state that students are not paying attention to the lecture 40% of the time, and, most disturbing of all, that 4 months after taking a course students knew only 8% more than a control group that never took the course.

The active learning approach appears to provide a more effective learning strategy. This concept is not

restricted to educational institutions. Most corporations "re-engineered" their businesses by empowering their employees. Similarly, students become the "architects of their own learning" [Verity 1994] [Graham 1992]. The underpinning of this approach is experiential learning theory. According to this theory [Kolb 1984], there are four learning styles that people use. These are the convergent, divergent, assimilative, and accommodative styles. The theory has many implications for business schools. First, our student bodies are increasingly diverse and their learning styles are very likely to be proportionately diverse since age, gender, and cultural factors often affect the learning styles used. It would appear that, to effectively meet their needs, these students must be offered more than one learning method. Second, if a key objective of education is to produce well-rounded, fully developed individuals, it is important to help students become integrated learners. Third, the marketplace demands creative and adaptive employees and this appears to also require an integrated learning style.

A large number of practical tools and strategies are being developed to create an environment where students can use more than one learning style and can actively pursue knowledge rather than passively receive it. Meyers and Jones [Meyers & Jones1993] describe the structure of active learning as being composed of elements, learning strategies, and teaching resources. The key elements are talking and listening, writing, reading, and reflecting. Students do not passively receive knowledge but must actively construct their own frameworks. Each student has a preferred learning style that involves using some combination of reflection, talking, listening, reading, and writing that works together to add to and refine his or her knowledge structures. Active learning strategies attempt to provide an environment in which students have some flexibility to direct their own knowledge acquisition and can combine more than one learning element to suit their learning style. Learning strategies include small groups, cooperative work, case studies, simulations, discussion teaching, problem solving, and journal writing. Teaching resources include readings, homework assignments, outside speakers, teaching technology, and television.

Other educators have applied technology to support feedback. Strasser [Strasser1993] discusses the use of E-mail to improve communication between student and instructor. Love and McKean [Love & McKean 1993] describe a real-time student feedback system where students can request a number of actions from the instructor. These actions include speaking faster or slower, using less technical language or summarizing, and so on. Students record their requests by pressing a particular key. The Internet has created new opportunities for extending the classroom. Web-based classes and other distance learning approaches offer many benefits. Bernie Dodge [Dodge1998] describes the use of WebQuests. A WebQuest is an inquiry-oriented activity in which some or all of the information that learners interact with comes from resources on the Internet.

The content of the MIS core course typically involves introducing students to information technology, business applications, information ethics and computer security. I had introduced an active learning component into the MIS course. My approach [Abraham 1995] applies the learning strategies of small groups and cooperative work to the core MIS course. It also introduces timely feedback, a key principle of Total Quality Management (TQM), into the course. I facilitated these strategies by using the teaching technologies of groupware and presentation software. Now I am teaching a section of MIS as an Internet-based class. In the rest of this proposal, I describe my attempts to port the active learning environment to the virtual classroom.

DISCUSSION OF THE APPROACH

There are two main aspects to the approach I adopted. One is to create a virtual classroom. Students should have more flexibility as to when and where they learn. This is particularly useful for students who work part-time, which includes most of our student body. It is also an opportunity for most Colleges and Universities to leverage their existing infrastructure. The World Wide Web (WWW) now makes it possible for most course materials, including lectures, to be made available to students wherever and whenever they choose to learn.

The second aspect of my approach is interactivity - an active learning environment in which students interact with the materials and direct their own learning. As some of the research discussed in the earlier section

indicates, active learning improves the quality of the learning experience. The Web once again proves to be a valuable tool in providing an interactive environment. Links to related Web pages allow students to follow a path of their choice. JavaScript and other programming tools make it possible to transform Web pages into dynamic, interactive learning tools. E-mail provides students with a means to communicate with the instructor and with classmates in an asynchronous mode.

The introductory MIS course has traditionally provided undergraduate business students with an overview of management information systems. Students are introduced to information technology (IT) and its application to business. In addition students are also expected to acquire some computer skills. I have broken down the course into eight learning units. These are (i) Introduction to MIS (ii) Hardware (iii) Software (iv) Managing Data (v) Business Applications of IT (vi) Telecommunications & Networks (vii) Internet and (viii) Social Impacts of IT. I also expect students to learn to use a graphics package such as PowerPoint or Presentations, become very comfortable surfing the Web, use an E-mail package such as Pine, use a file transfer package such as Rapid Filer or WS-FTP, and learn to create their own Web pages. My course outline is posted on the Web at the start of each semester. It provides a detailed description of the course objectives, student obligations, class schedule and grading scheme.

The learning units are now being published as Web documents. A central switchboard allows students to choose a specific unit. Each unit has a main page containing links to other related materials. This main page typically contains the learning objectives of the unit, a link to lecture notes, links to articles on major figures (such as Larry Ellison or Andrew Grove) and major companies in the area of discussion, historical trends, review questions, class exercises and a sample quiz. The lecture notes were constructed using Microsoft's PowerPoint (Office 97) to create a set of slides and publish them in HTML. The software automatically creates an interactive set of frames that allow students to either view the slides (in any order) or print out the notes in outline form. JavaScript is automatically generated for this purpose.

Students E-mail me at the start of the semester. I take their addresses from these messages and create a class E-mail list. This allows me to reach all the students when I need to make any announcements or pose questions or respond to them. Also, students are encouraged to carbon copy that list when they send in comments and suggestions. The first individual class assignment requires students to learn to use a graphics package such as PowerPoint (Microsoft) or Presentations (Corel).. They then construct a series of slides or charts using the software. In addition to learning a useful skill, this exercise also plays a part in integrating other assignments such as the cooperative student project discussed below. Teams presenting their project now have an impressive visual aid to help enhance the experience.

Students create a similar presentation of their own and hand in either a printed copy of the charts or attach an electronic copy to E-mail. They usually get about 10% of their overall grade for completing this assignment. Every chart of each student must be unique - this results in very creative, and occasionally disturbing, output! After successfully completing this assignment, most students become comfortable with the software

Teams of two to three students are formed early in the semester to carry out a cooperative student project. The project consists of researching a specific area of MIS and presenting the research findings or the system developed to the rest of the class. In the process of carrying out this assignment, I believe that students learn a lot about MIS, acquire new computer skills, and improve their communication, creativity, learning, and group skills.

Teams select a topic of their own choice. They could analyze an existing information system, design and/or develop a new system, compare various software packages or hardware devices, or research a topical area. The objective here is to promote self-directed learning and creative choices. Next, each member of the team conducts a WebQuest to research the topic. The final stage of the project involves presenting the project to the class. Despite the discomfort that presentations cause, they are an important pedagogical tool and learning experience. The sharing of experiences among students can also be a very effective means of learning. As noted earlier, talking and listening are two of the basic elements of active learning. Students can improve their communication skills by watching and participating in these presentations. Graphics packages like PowerPoint help students make professional presentations. Starting around mid-semester, teams of students present their term projects to the rest of the class.

As discussed earlier a WebQuest is an inquiry conducted on the Internet. Each member of a team conducts a longer-term WebQuest [Dodge 1998] to research some part of the topic chosen by the team. They surf the Web looking for interesting Web sites and identify at least 3 URLs that provide relevant material for their topic. Each member of the team creates a Web page containing a summary of the materials they found on the WebQuest. They insert links to interesting sites that they found. Each Web page is analogous to a poster in a poster session [Drummond 1998].

There are a few procedures I use to help manage the approach effectively. I make sure the students know what to expect by providing them (on the Web) with a detailed course outline. This outline clearly describes the objectives of the course, grading policies, classroom procedures, and a tentative class schedule. It fulfills the requirements specified by active learning theorists [Meyers & Jones 1993]. I allow students to join any group. However, to provide some control over the group processes, if the majority of a group complains about any member, that person must complete the project individually. Students recognize that their success depends partly on maintaining a good working relationship with their teammates.

Generating ideas for the project is a crucial step. In the past, this step often ran into a number of difficulties. Some teams would wait till the last possible moment and pick a topic randomly from the textbook. Most teams would generate only one or two topic choices. In fact, a number of teams would pick the same topic, usually something that was discussed recently in class. I have attempted to improve this process by spreading the presentations over the second half of the semester and assigning chapters to each team. Topic selection must be guided by certain criteria. The criteria include relevance, usefulness, audience interest, and feasibility. The topic must be relevant to the course, must be useful to the team members, should be of interest to the rest of the class, and should be feasible in terms of resources. If more than one team picks a topic, there must be other choices to pick from. It is often useful to stress that topics should be connected to their own interests, both personal and professional [Shack 1993]. Once the topic is selected, the instructor should approve it and monitor the teams' progress. As with any group project, I have encountered problems such as procrastination and loafing.

I insist that graphics software be used in the presentations. The presentations are usually about ten to fifteen minutes long and attendance is compulsory. The rest of the class is expected to take notes on each presentation since they are included as material for the final exam. The teams must also turn in a one-page summary or outline of their presentation.

I created the main page for each learning unit using Word for Windows 95, a word processor built into Microsoft Office 97. I published the document in HTML format to generate the Web page. I edited the resulting document in Word Pad, a simple word processor built into Windows 95. I used my rudimentary knowledge of HTML and a couple of templates downloaded off the web to get the look I wanted. To create the lecture notes, I selected some slides from the textbook support materials. I used PowerPoint to add additional slides or modify existing ones. I then published the presentation in HTML format. This is a very nice feature in recent versions of the software. PowerPoint automatically creates a four-frame page for viewing the presentation. One frame presents the slides in GIF or JPEG formats. A second frame provides an outline of the presentations. A third frame provides a navigation toolbar for the images. The fourth frame has two buttons - clicking on one presents a detailed outline in frame two and clicking on the other present a summary outline. I recommend that students print just the outline of the lecture instead of the whole page. I modified the index button on the navigation bar to point back to the main page of the learning unit. Finally, I used WS_FTP95, a freeware file transfer program to upload all the html documents to the Web server. I also used a program called Rapid Filer on occasion. Rapid Filer is built into the NetWare operating system and can be used from any NetWare workstation.

RESULTS

As with most instructional approaches, it is difficult to precisely measure the effectiveness of my method. To conduct a scientific experiment, I would have to have a control group which would be excluded from using this

teaching approach. For ethical and practical reasons, this was not possible.. In the first test, I found that students from this section scored somewhat better than their counterparts in a regular classroom section. I find that students are more enthusiastic about the course, make better presentations, and occasionally make helpful suggestions that improve the class. By exposing students to a variety of learning strategies, this approach allows a diverse student body alternative paths to knowledge acquisition while promoting a more integrated learning style. Finally, the tools themselves update the traditional skills component of the MIS class by replacing spreadsheets and word processing with graphics and Web page design.

Students have consistently rated the term project and computer labs as being the most useful and enjoyable parts of the course. They have used presentation software in other courses and pressured other faculty to use the multi-media rooms. After they become comfortable with web-browsers and E-mail, students will often stay on after the class to complete a session. This is in stark contrast to their behavior at the end of a lecture!

A few aggressive or better-informed students tend to dominate class participation in the traditional classroom. By promoting E-mail as a means to participate, I have found that students, who would otherwise be silent, begin to participate enthusiastically. Information sharing improves too. For instance, one student recently sent me mail asking me for help on how to buy a PC. I forwarded this to the rest of the class and soon she received four or five very useful suggestions on where to shop and how much to pay.

Feedback is a critical component of any quality initiative [Thomson 1993]. Feedback from students, however, is unfortunately usually overlooked. Student evaluations are usually collected at the end of the semester when there is little motivation to make suggestions. Very often, the time provided for filling out the forms is limited. Our method uses E-mail to collect feedback from students in the middle of the semester when their suggestions can still be implemented. Feedback to the students is also speeded up. Often, I can post grades on the Web within a few hours after the test or quiz.

Cooperative student projects improve social skills and prepare students for the real world [Bruffee 1987] [Meyers & Jones 1993] [McKinney 1993]. Our students have been exposed to team projects in a number of courses and are increasingly comfortable with the format. Once they understand that they can "fire" a team member for not contributing they feel more in control. These procedures also tend to keep potential free riders in line.

There are a few drawbacks and caveats to using this method. First, obtaining multimedia rooms and computer labs are not always feasible. Perhaps, one day, every classroom will have a computer and screen instead of an overhead projector and every student will carry his or her own laptop. A short-term solution could be for the multi-media center to provide a mobile setup on request much as they now deliver TVs and VCRs. At our school, all the classrooms have sockets that allow one to plug into the Internet. Computers that attach to overhead projectors are also available and seem to offer an attractive alternative. Second, as with any technology, the potential for breakdowns exists. We have all occasionally been in situations where the projector didn't work properly or the whole system went down. Web servers can crash, FTP programs can stop transfering files and some browsers may not support certain features. Third, some students are still uncomfortable with computers and may not have easy access to the Internet. Fourth, some students get so caught up in trying to make dazzling charts and web pages, they err excessively on the side of style over substance. Fifth, this approach can be very time-consuming. Preparing the course materials took a great deal of time. Monitoring the E-mail and downloading files was also very labor-intensive.

Colleges and Universities are looking to the Internet as an opportunity to expand their course offerings while maintaining the same infrastructure (faculty, buildings, labs, etc). This paper described an approach used to adopt an active learning environment within an Internet-based course. I described how I used the Web, E_mail and graphics software to support a cooperative student project in the core MIS course. Information Technology itself is a key topic in the course and so it is naturally a very appropriate medium for instruction. Students learn about information technology by using computers and accessing information through the Internet. Preliminary results seem to indicate that students are enthusiastic about using a 'high-tech' approach to learning, especially if it is grounded in active learning methods.

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Applying Cluster-Based Connection Structure in the Document Base of the SDI System

Abstract: Since 1994 in Poznań University of Economics has been implementing a Selective Dissemination System (SDI) for economic information [see Abramowicz and Piskorski 1997]. To build the SDI system more efficient there has been applied mechanisms based on methods of cluster analysis. One of the most important mechanism is the cluster-based connection structure (CCS) developed in 1997 (Dariusz Ceglarek doctor's dissertation) and described in [Abramowicz and Ceglarek 1998]. This paper describes new mechanisms, which improve the SDI system. Using the CCS structure a user of the system can improve (a) relevance calculation for newly provided documents, (b) navigation in a document base, and (c) presentation of the set of documents according to the relevance.

1. SDI Systems

In SDI systems users (we call those information consumers) have expressed their interests in using consumer profiles, those are sent back to information producers. Terms in consumer profiles have weights, which describe their significance for the consumer.
Information producers, using a distribution system, check, which of the produced documents are relevant to the consumer profile. These, which are similar to his - her profile are then send to him/her. First the consumer validates received documents, then rejects the non significant ones. Because of this procedure the weights of terms which appear often in rejected documents, are diminished, and weights of terms which appear often in accepted documents are increased. Such an improvement of a consumer profile uses a feedback mechanism to gather more relevant information. This helps the consumer to rebuild his profile to achieve only interesting documents. The distribution system improves consumer's profile.
Unfortunately, the SDI systems used today, do not have the mechanisms, that would enable them to answer the question: which of the documents in the user's database are similar to specified document and in what scale they are similar to each other? In those systems there is a lack of synthetic information (measurement) about similarity between documents. Furthermore, during validation of new documents, SDI systems do not provide the mechanisms to compare[1] them with documents already placed in the document base.

2. The Cluster Analysis

The basic idea of the cluster analysis[2] is clustering of objects based on their similarity in the space of features. In the information retrieval systems (IR), the clustering of objects features means a gathering of terms from a profile of analyzed document or a group of documents. The measure of similarity is then coefficient of taxonomic similarity. The cluster analysis leads to exhaustive and separable classification - a defined document belongs to at least one and no more then one cluster. This method of classification has been shown in [Cutting et al. 1992]; [Lewis 1992]; [Botafogo 1993]. In the article, there a more complex connection structure between clusters with using data, which originate during iterative procedure of typical cluster analysis. Thanks to this more complex cluster-based connection structure (CCS) in the document base, a document can be an element of any number of clusters at the same time. The obtained CCS is partially hierarchical (smaller clusters are elements of larger clusters - see picture 1[3]). But, there are also connections, that are not hierarchical (a document has connections to clusters, not being its element), there are also connections between clusters, which are not in the generalization relationship.

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[1] Comparison should be understood as an assignment of the similarity metric.

[2] Methods of cluster analysis have been described in [Bijnen 1973],[Sokal and Sneath 1973]

[3] On the picture 1 there are 3 small clusters A,B and C. Each of them is an element of bigger cluster D.

Based on CCS, and using the algorithms proposed, a consumer can improve the following processes: see abstract

- The selection of newly provided documents
- Navigation within documents from the document base
- Presentation of result of a query

3. The Algorithm to Build the CCS in the Document Base

Given is a consumer profile $P = \{p_1,..., p_n\}$, defined as a set of n terms.
There is also a set of δ documents, which makes the document base $\Delta = \{\Delta_1,..., \Delta_\delta\}$.
For each document in Δ_i there is a defined profile of document $D_i = \{d_{i1},..., d_{in}\}$. Non-zero values d_{ij} are sets of terms from the consumer profile, which appear in documents.
Besides this, there is a set of weights $W = \{w_1,..., w_n\}$, that assigns significance, that the consumer attaches to each of terms from a profile P.

The distances between objects (documents or clusters of documents) of the document base apply for the following relations:

- document ⇔ document
- document ⇔ cluster
- cluster ⇔ cluster

All those relationships are explained below:

Measure 1: (document - document)

To define similarity between documents there is used a measure of cosine:

$$SIM(i,j) = \frac{\sum_{k=1}^{n} d_{ik} \cdot d_{jk}}{\sqrt{\sum_{k=1}^{n} (d_{ik})^2 \cdot \sum_{k=1}^{n} (d_{jk})^2}}$$

Measure 1 will be used in the article to establish a similarity between documents, what will be done during the first step of algorithm of building CCS between elements in the document base.
However, in the measuring similarity of multi-document clusters (a document is simply a cluster having just one element), the fact, that a term belonging to a cluster's profile, does not mean, that it is frequent in this profile, and, that it is typical of this cluster. If the documents profile, that is attached to a cluster has the same terms, as the cluster's profile, it means, that this document is certainly the most similar to the cluster's profile. But, if in the documents profile there is a lack of important term typical of the cluster's profile, it means, that this document is less similar to the cluster than the document, in which there is a lack of terms, which are in cluster but with a low importance for the consumer.
In each step of an iterative procedure of connecting documents (just after connecting them), there is correction of distance between just done cluster and remaining documents.

Measure 2 (cluster - cluster and document - cluster)

There is an assumption, that for each cluster at its profile there is stored information about the number of documents, in which there were defined terms. For i^{th} cluster there is:

$L_i = \{ l_{i1},.... l_{in}\}$ and
$L'_i = \{l'_{i1},..., l'_{in}\}$,

where $l'_{ij} = l_{ij} * w_j / s_i$
s_i – a number of documents at i^{th} cluster
w_j - a weight of significance of j^{th} term.

l'_{ij} means participation (representation) j^{th} term at the whole profile of i^{th} cluster. L'_i will be called a structure of i^{th} cluster.
The distance between two clusters will be there $o_{ij} = 1 - (D'_i \cap D'_j) / (D'_i \cup D'_j)$ i.e. measure showing how much clusters differs in structure of terms of the documents profile. The formal notation:

$$o_{ij} = \frac{1}{\sigma} \sum_{k=1,n} \left| l'_{ik} - l'_{jk} \right|$$ for there k, for which $l_{ik}+l_{jk} > 0$ (there are σ of them).

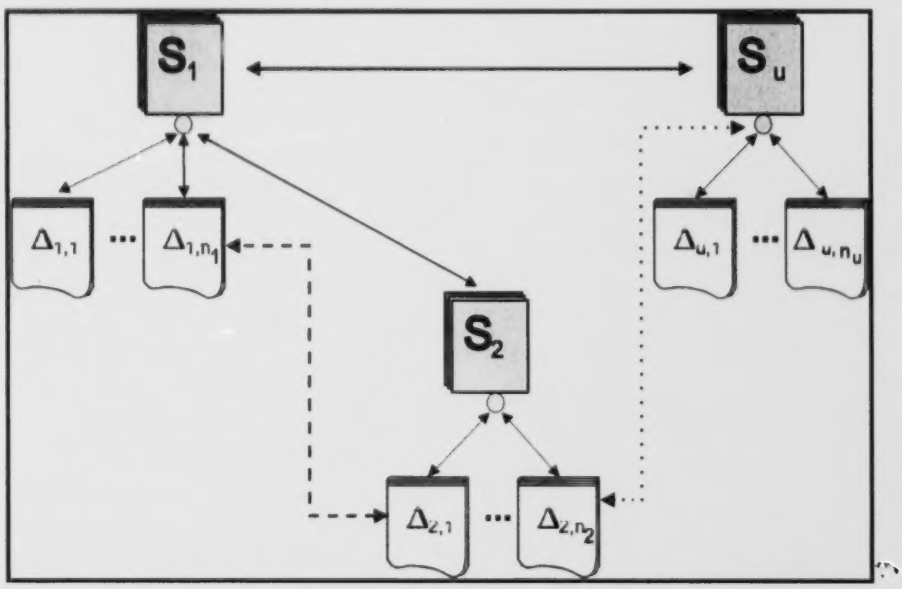
Steps of the algorithm for assignation the CCS in the document base:

Step 1: For the whole document base, each document becomes the set of nodes of graph and at the same time it becomes cluster of one element.
Step 2: For the whole document base there are calculated distances between documents according to the measure 1. In the graph of similarity there are stored only links connecting documents with similarity not smaller than α. The coefficient α is assigned by consumer.
Step 3: Documents are set to elementary clusters[4]. The gathering goes on as long as the similarity between connecting objects (document - document, document - cluster) becomes smaller than the coefficient α (stop criterion).

Step 3a: For each document (which belongs to an elementary cluster) there are assigned clusters strongly connected to it (above some value of similarity measure - coefficient α). The calculation to assign this list of clusters is made after step 3, because only then the ultimate structure of the elementary cluster is available. If the similarity between document Δ_i and the elementary cluster S_j is larger than α, a link Y_{ij} to the list of clusters links near to Y is introduced.
Step 4: The elementary clusters are gathering together in larger structures as long as the similarity between connected clusters become smaller than α. The number of clusters, which is achieved after ending the gathering, will be assigned to ω.

The algorithm has been described (in pseudo C++ language) in [Abramowicz and Ceglarek 1998]. There has been also shown that it has computational complexity higher than linear and lower than quadratic. The algorithm gathers documents into clusters and establishes a CCS structure in the document base in deterministic way.

The structure CCS built up this way (graph showed on **Picture 1**) enables to look at the documents with many aspects. For example: a document signed $\Delta_{2,n2}$ except belonging to cluster S_2, has indicator to a cluster S_n (S_n is close in relationship to this document).



Picture 1: Connection structure in the document base generated by algorithm CCS

[4] The elementary cluster is a cluster, which does not contain any cluster, but only documents. Documents, which do not belong to any cluster, are these, that were not similar enough to any document and do not have any link s connecting them to the X list. So, there is no reason to analyse them from the point of view of similarity to any connection.

Having CCS, the consumer can navigate:

- to a defined document through similar to it or close to it documents,
- to a defined document through clusters, to which belongs („more general" - „more detailed"),
- to a specific defined cluster, through „more general" cluster or „more detailed" cluster for it.

During the clustering in part III of the algorithm, there originates information about a nearness of elementary clusters. The fact, that finally they become elements of different, non-elementary clusters (it may happen), does not mean a loss of nearness between them. Inclusion in structure of connection between clusters, the clusters near to each other, enables to move through clusters not connected hierarchically („related" - „more general" and „more detailed").

For example on the Picture 1 there are connected clusters S_1 and S_2. There is assigned a connection between clusters, if a similarity becomes larger than coefficient α, during absorption, one of these two connections by another or by absorption another cluster by one of these two clusters. The fact, that the elementary clusters become the element of the same, not elementary cluster, does not mean deletion of connection between them.
The CCS can be also achieved by not precisely stated and not deterministic classification, provided by the algorithm Buckshot, which has been demonstrated in [Cutting et all. 1992] and in [Hearst et al. 1996]. Because it splits a collection of objects into definite number of clusters, there are required some modifications to obtain the similar structure, like the one at shown algorithm CCS. The inaccuracy of that algorithm, is there made up by its speed.
For new documents in the document base, for which clusters are already assigned, the procedure is different. It should find a cluster, which a document should belong to (also it should find indications to clusters, in which documents are very similar to the definite one) and assign the influence of the new document on the already originated clusters. To estimate a cluster, which the new document should belong to, we may of course look through all the originated clusters, but also we may find another solution - namely: the elementary clusters are looked through and the most similar to the document is chosen.

4. The Mechanisms of Assistance the Consumer of Information

4.1. The selection of new documents

With a new document, the consumer gets from module of distribution a profile of the document and its relevance in relation to the consumer's profile. Till now, for this document [see Abramowicz 1991],:

- choosing term from a profile of documents, the consumer could get the next document, in which there is definite term,
- choosing term from a profile of the document, the consumer could get a set of documents having this term (term as a query),
- explicit information about relevance - this part of a profile of the document, which is not in the profile of the consumer, and which comes from profiles of other consumers, for whom this document was also relevant. The consumer can treat this information as an instruction. This could cause, him to get similar documents with higher probability.

For a new document, owing to a CCS, the consumer can get:

- Documents, which are the most similar to this document. The search is made in centroid way [Salton. and McGill 1983].
- The most similar, with this document, cluster or a centroid of this cluster to acquaint the subject typical of this cluster.
- One of the clusters, highly similar to the document (the information originates during estimation at the former point).

Beside that, the consumer can use a connection between these clusters and other clusters, according to possessed structure of clusters and navigate in the document base. Owing to this, the consumer can compare the relevance and the quality of a new document that is highly similar to it documents that are already accumulated in the document base.
The acceptance of the document by the consumer means, of course, the addition it to the base, but also inserting the connections into the CCS of the document base.

4.2. Navigation in the document base

For the document selected from the document base (in the navigation procedure in the set of answer to the query), till now:

- choosing term from a profile of document, the consumer could get next document, in which there is definite term,
- choosing term from profile of document, the consumer could get a set of documents having this term (term as a query),
- explicit information about relevance - this part of a profile of document, which is not on profile of the consumer, as an instruction, what could contribute to obtain similar documents with higher probability.

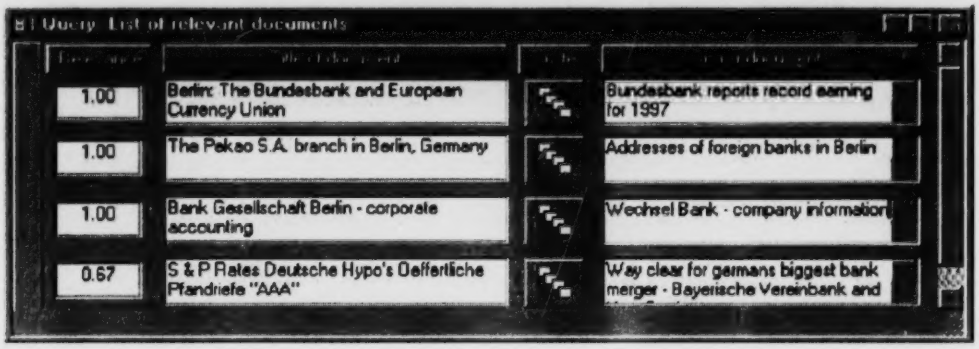
However, this information does not enable the consumer to find documents not having definite term, but strongly relevant to it. For example: the consumer requested system to find documents having terms „insurance" and „policy". Obtained set of documents, which fulfill these criteria, we designate as S. If seems, that is a good point to start to search for documents about estimation of insurance risk, according to the state of health. In the document base there is a document, which does not have a word „insurance", but it has „risk", „estimation of risk", „policy", „opinion about health", „insurance analysis". After getting the set of documents fulfilling criteria, the consumer asks to inform about:

- the cluster, of which element is one of documents from set S (to inform about it, because it is already assigned),
- the list of clusters similar to a document from set S,
- the cluster, which is the most similar to a document from set S,
- one of clusters connected with a document from set S (to inform about it, because is already assigned to),
- one of clusters the most highly similar with the whole set S. There should be done some calculations, because S every time can be different.

The calculations are done according to measure 2 e.i. $SIM(S, S_i)$ for $i=1,...,\delta$.
This enables to find documents, which, to be sure, do not have any terms from query, but by belonging to the same clusters are strongly connected.
In each of above variants, the consumer of information can go from definite cluster to one of its specializations (subcluster) or generalization (more general cluster - this one, which definite cluster belongs to).
During estimation of definite document from analyzed cluster, the consumer, gets information about connections between document and cluster. He may learn how much of them differ in regard to structure in comparison with current cluster.
Example: The estimated document is: "car accident insurance - analysis of offers of the insurance companies" which belongs to analyzed cluster S1 „ property insurance". Cluster S1 and S2 differ about structure in significant way in relation to terms „cars" (for example suitable values differ of structure amount 0,99 and 0,60), „real property" (for example - suitable 0,1 and 0,6) etc. It is a result of a subject of documents of both clusters. So, the consumer can acquaint subject of the cluster S_2 without looking through documents of the cluster S_2!

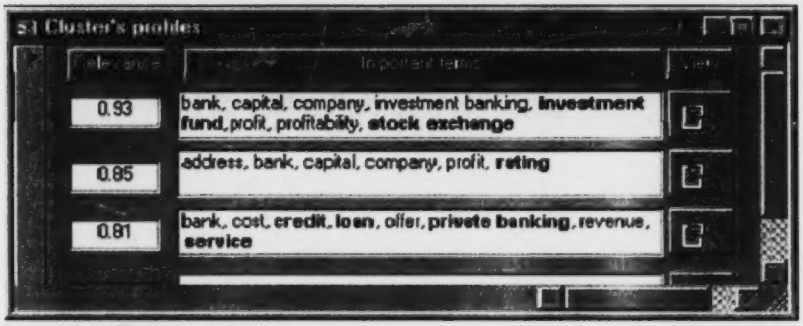
4.3. Mechanism of assistance presentation of the result of a query

The SDI system has a build-in retrieval system, which built answers to queries. The main task of the retrieval system is to retrieve the appropriate information in answer to queries submitted by the consumer. Applying the CCS structure may be useful during a presentation of a result of a query because the CCS structure gives additional information about documents. In the result of the query built by the search system the consumer gets a set of documents from the document base which are relevant to the query. The set is presented to the consumer as a list of documents in order of relevance value (see Picture 2). Each of these documents from the list has additional information about it's cluster (the cluster it belongs to) - within the confines of the CCS structure. The document has also information about other documents which are very similar to. The basic function in this moment is to look over the list and to read documents. The consumer can move, from any document from the list, to it's cluster or to similar documents. Afterwards he may continue navigation in whole document base owing to the CCS structure. Naturally, there is no obstacle to return to the list.


Query: List of relevant documents
1.00
Berlin: The Bundesbank and European Currency Union
Bundesbank reports record earning for 1997
1.00
The Pekao S.A. branch in Berlin, Germany
Addresses of foreign banks in Berlin
1.00
Bank Gesellschaft Berlin - corporate accounting
Wechsel Bank - company information
0.67
S & P Rates Deutsche Hypo's Oeffentliche Pfandriefe "AAA"
Way clear for germans biggest bank merger - Bayerische Vereinbank and

Picture 2: List of relevant documents

Example: The query condition contains three following words: "Germany", "Berlin" and "bank".
Let's assume that analyzed document is about the branch of polish bank Pekao S.A. in Berlin. Owing to the CCS structure the consumer can examine the cluster it belongs to (probably the documents from the cluster are related to the bank). He may also examine the documents similar to it e.g. documents about branches of the bank in other countries.
When the set of documents is heterogeneous, e.g. documents refer to several fields of knowledge or couple of subjects, it is proper to divide it into clusters. Profiles of documents from the set are used to dividing the set into clusters. The result of division is k separate clusters[5], where k is a number specified by the consumer. If any of obtained clusters is recognised by the consumer as a heterogeneous, he may decide to dividing it into several smaller clusters. Each of the k clusters has his own profile (see Picture 3). The consumer can examine the cluster's profiles and can choose this cluster which profile is the most interesting for him. On the picture 3 terms which are specific for given cluster (i.e. they appear more often than on the average in all clusters) are in bold type.


Cluster's profiles
0.93
bank, capital, company, investment banking, investment fund, profit, profitability, stock exchange
0.85
address, bank, capital, company, profit, rating
0.81
bank, cost, credit, loan, offer, private banking, revenue, service

Picture 3: Profiles of clusters

5. Conclusion

In this paper the cluster-based connection structure (CCS) in the document base of information's consumer has been presented.
This structure enables to obtain additional knowledge about information accumulated in the document base. This knowledge, by using suitable algorithms, is conductive to overcome difficulties connected with estimation the usefulness of new documents, to navigate in the document base already accumulated, and to search for information in the document base.
The reason to gather this knowledge is the designation of similarity between objects, for which there are defined mutual connections. These objects are documents and clusters of documents, and a measure of similarity is defined based on document's profiles or profiles of clusters. In our paper two measures of

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[5] A division analogous to the CCS structure (inseparable) was acknowledge as inexpedient because each query requires new division.

similarity have been proposed: the similarity between two documents and the similarity between documents (or clusters) and clusters.

Obtained CCS structure enables an information consumer to improve the document selection process, in which producers provide information to consumers. Improving the document selection means, that the consumer can compare delivered him documents with documents already accumulated in his document base. On demand of consumer system provides him clusters, profiles of which are the most similar to profiles of a new document. The consumer can then give feedback, if already provided documents introduce new information in relation to similar in the subject documents from the base of already accumulated documents.

Next process, in which the consumer of information is assisted by, defined in the article, CCS in the document base, is navigation in the document base, namely in the assemblage of documents, which are an answer to a question leaded to a search system. During navigation in the document base, the consumer, owing to CCS, can get a set of documents, which is similar in a subject to the present analyzed document or group of documents. The consumer can also compare a profile's structure of analyzed in turn cluster, what enable the consumer to achieve the estimation of these cluster's opinion different in a subject. Difference in structures of two clusters provides the consumer with information where are the differences between this cluster and formerly analyzed clusters, so it informs what subject should be expected in average document of cluster, which the consumer would like to look through.

The last process, in which the consumer is assisted by, is presentation of the result of a query. A set of documents, which are relevant to a query is divided into separate clusters. This enables the consumer to compare difference between obtained clusters and then enables to choose the most interesting one.

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DReSS 2.0: Lightweight Groupware for Hypertext Publishing on the Web

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Abstract: We present recent evolutions in the development of *DReSS*, a "*D*ocument *Re*pository *S*ervice *S*tation". DReSS allows World Wide Web users to collaboratively create and maintain hypermedia documents on a Web server without the need for a login (or ftp upload) access to the server machine. DReSS emphasizes the manipulation of hyperdocuments consisting of several files that are linked together. DReSS is a small system, that is easy to install on any Web server, and that offers users the ability to up- and download sets of files. At the Eindhoven University of Technology DReSS has recently been integrated with an adaptive courseware system to enable students to upload assignment work to the Web-server containing the course text and the assignments. New features in DReSS 2.0 include the ability to use a browser's upload capabilities, a new and more user-friendly user-interface, the ability to use a browser's upload facilities, and machine independent client helper applications and server-side scripts, all written in Java.

1. Introduction

World Wide Web (or WWW) [Berners-Lee 94] is a distributed publishing platform. Authors create and change documents locally and upload them to a server, where they can be accessed by their collaborators. While downloading (or "reading") documents is usually allowed for everyone, and done in an anonymous way, authors need login or ftp upload permissions on the server machine in order to publish their documents. Alternatively, in a local area network (Intranet) the server may have access to the author's machine or home directory, and copy or even serve the documents from there. To avoid the need for such permissions some document repository systems have been created like BSCW [Bentley 95] and DReSS [De Bra 95].

Groupware is defined [Bock 95] as a computer based system that supports people in the execution of common tasks (or the achievement of a common goal) and that provides an interface to a shared environment. Document repository systems represent a lightweight form of groupware: they offer uploading and sharing of documents among varying groups of authors. Through Internet technology we can create shared workspaces that can be reached from outside the institute or company (see also [Goossenaerts 97] for a business oriented application of a shared workspace) and support collaboration in geographically distributed environments. Apart from shared workspaces systems like BSCW also offer (threaded) discussion groups and on-line meetings.

DReSS (for *D*ocument *Re*pository *S*ervice *S*tation) has been developed at the Eindhoven University of Technology. It is a tool that provides collaborative information sharing; it enables authors to move hyperdocuments to the WWW server and to update such documents later on. The emphasis of DReSS is on the support for *hypertext* documents, i.e. for documents that consist of a possibly large number of small files that are connected by hypertext links. BSCW (Basic Support for Collaborative Work) is sometimes compared to DReSS because both systems offer shared workspaces. However, DReSS is specifically designed to be *just* a document repository, while BSCW aims at providing more complete support for collaborative work, and therefore includes many features not found in DReSS. The strong points of DReSS are the transparent use of URLs, and the ability to upload sets of files in one operation. BSCW is only able to resolve hypertext links (using the HTML <A> tag) in some limited cases, while DReSS handles links transparently, even between documents in different workspaces. At the Eindhoven University of Technology we have integrated DReSS into an adaptive courseware system [De Bra 96, Calvi 97] in order to enable students to upload assignment work to the Web-server containing the course text and the assignments. Such assignment work typically consists of sets of pages

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that contain links to each other and that also contain images, applets, and possibly other types of objects as well. It is important for students to be able to upload assignment work in a single operation, and perform validation tests on the uploaded work immediately.

2. Document Repository Systems

2.1 Requirements for and History of DReSS

The main reason for using a document repository system is to avoid the need for authors to have login or ftp upload permission on the server machine, or for shared file systems between clients and servers. More advanced features like link databases, versioning, and on-the-fly generation of indexing information are worthwhile, but secondary to the goal of providing a document repository system that is easy to install and use, and that can be used with different browsers (and servers) without requiring any modifications to "standard" WWW software. In 1995 *DReSS*, a tool that turns a WWW server into a "*D*ocument *Re*pository *S*ervice *S*tation", was introduced (version 1.1 was described in [De Bra 95]). DReSS enables authors to move documents to the WWW server, and to update documents on the server, without compromising the server's or client's security. To ensure that the security of the server and the author machines is not compromised by using DReSS, the set of requirements given below contains several constraints related to security:

- Authors need no login permission on the server machine.
- The server machine needs no (NFS) access to the author's home directory (or any other directory on the author's machine).
- The author's machine must not need to host an ftp- or WWW-server in order to upload documents to the main server.
- All communication is done by means of HTTP. (This may be changed to S-HTTP or HTTP over SSL at a later date for better security.)
- The system must use standard and/or platform independent software: unmodified WWW browsers and servers, and only Java programs where additional software is needed.
- Most of the functionality of the system must be implemented on the server machine (so as to use "thin" clients).
- The author's WWW browser is the user-interface for the whole system.
- Elaborate access control is needed. The Webmaster must be able to decide which authors may create and edit documents in which directories and the authors must be able to decide who may edit and view their documents.
- The system must prevent simultaneous editing of the same document by different authors.

DReSS, version 1.1 met most of the above requirements. It used CGI-scripts on the server side, and two small auxiliary programs on the client side that were completely invisible to the author. These programs were based on the common WWW library (from W3C) to ensure easy portability. However, that WWW library proved to be difficult to port to non-Unix systems such as Windows-3.1 and Windows-95. Version 1.1 of DReSS was written in C and used on Solaris (release 2.4 on both Sparc and x86) and SunOS 4.1.3 for both the client and server, although client and server could run on a different OS.

Several changes in the IT-environment have taken place since the introduction of DReSS in 1995. A standard for file uploading was defined (cf. RFC 1867 [Nebel 95] which is supported by such browsers as Netscape Navigator. Office environments like the MS-Office and the Wordperfect Office suite offer built-in support for HTML-editing. The Java programming language has been introduced and has found widespread support and usage for Internet/Intranet applications. These developments have led us to reconsider the design and implementation of DReSS to take advantage of these developments. This led to the present version of DReSS: version 2.0. Our key design goal has been to build a low key application that requires a minimum of changes to the Web-client and -server. To make version 2.0 of DReSS portable, both the client helpers and server scripts are written in Java. For DReSS 1.1 two client helper programs were always required. In DReSS 2.0 these helpers are only required for handling hyperdocuments that consist of several files. Single file upload and download can be handled by any modern browser (which supports RFC 1867). The two helper programs perform the following functions:

- When a document is retrieved from the server, a helper program can be used to start a local editor (instead of just saving the document on disk).

- When the author has finished editing the document a second helper program uploads the document to the server. (The browser can do this as well, for a single file.) When a set of documents is uploaded to the server, the transfer is performed using a single HTTP request. (In DReSS 1.1 uploading a set of documents required a request per file.)

2.2 Client- and Server-Side Helper Applications

The architecture of DReSS (and also of the document repository part of BSCW) consists of four standard components and two types of helpers. Figure 1 shows this architecture.

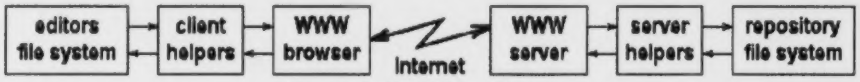

Figure 1: DReSS architecture

- On the client side the author of a document is using a standard editor (for text, images or other data types) to create and modify documents, and a browser to interact with the repository system on the server.
- A client-helper application guides the communication between the editor(s) and the browser. It ensures that the editor receives as input the document which the browser received earlier from the server. It also ensures that when the server sends an archive containing a set of documents the individual files are extracted from the archive before an editor is invoked. Another helper ensures that the document is sent back with the appropriate name, and also takes care of uploading sets of documents.
- On the server side a database (called "repository") maintains not only the documents but also some meta-information and history of each document.
- A server-side helper, in the case of DReSS a CGI-script, handles the communication between the Web server and the repository system. It generates appropriate confirmation or error messages for each request from the browser, and it archives sets of documents before sending them to the browser and extracts them from archives before depositing them back in the repository system.

The basis for activating the correct helper program, and for using the correct archival formats is the use of MIME-types. (MIME stands for Multi-purpose Internet Mail Extensions.) A WWW-browser has, as part of its configuration, a list of MIME-type/application pairs. When a Web-server answers a request it sends an HTTP-reply to the server. This reply consists of a standard header, possibly followed by a document. The Content-Type field of that header defines the MIME type of the document that follows. The browser checks its list to determine whether it should try to display the document all by itself, whether to use a plug-in the user has installed, or whether to use a separate (external) application. In order to use DReSS, a special new MIME type needs to be added to the browser's list, and bound to the appropriate helper application. (On a Unix system this binding can be done in the user's .mailcap file, thus without changing any of the browser's settings.)

Up- and downloading multiple files is achieved through the use of multipart MIME types (as defined by RFC 1521). This eliminates the need for special archival programs on the server- and client-side, of which few are readily available on all platforms. The DReSS helpers take care of bundling and extracting files to and from the multipart messages.

The possibilities of file systems for maintaining status information about documents are insufficient for document repository systems. DReSS maintains the following information about a document:

- **creator**: the author who first created this document; this info cannot be changed.
- **current author**: the author who is "currently" editing the document.
- **lock status**: when an author wishes to modify a document, that document is "locked" and the author becomes the "current author"; only the current author can release the lock.
- **authors**: the authors who are entitled to modify this document; this is like the Unix "group" concept, but each document by have a different set of authors, without the need for explicitly naming groups beforehand.
- **log file**: a log of all actions (downloads and uploads) performed on the document.

Unlike BSCW DReSS does not have a versioning system, which provides access to all versions of a document that ever existed. Documents are stored as files on the Web server and are available through the URL, which corresponds to that file. This makes it easy to use hypertext links between documents in the same and in different workspaces. The files on the server are all owned by the WWW server daemon. Ownership information is kept in the status database.

3. User-Interface for DReSS

While working with DReSS version 1.1 we identified several points that needed attention to improve the usability of DReSS:

- DReSS 1.1 only supported one editor (the default was Emacs, but this could easily be changed). DReSS 2.0 supports more editors and a dialog for configuring the editor from within the browser. For different media types such as text, and images, different editors are needed, but also for different textual document formats such as HTML, and MS-Word.
- The original dialog between the user and DReSS was too complicated. The user-interface almost always displayed many buttons for actions that were not possible in the current state. Figure 2 and Table 1 show the (simplified) state-transition diagram for DReSS 2.0.
- The upload protocol supported by DReSS 1.1 was implemented using an ad-hoc encoding, thus preventing the use of the emerging browser-capability to upload files according to RFC 1867. DReSS 2.0 uses the protocol of this RFC, and allows single file upload from within the browser. (Multiple file upload is still handled through a helper application.)
- The multi-file upload in DReSS 1.1 was limited to uploading an entire directory. In DReSS 2.0 uploading specific sets of files can be done through the client uploader interface, which is shown in Figure 3.

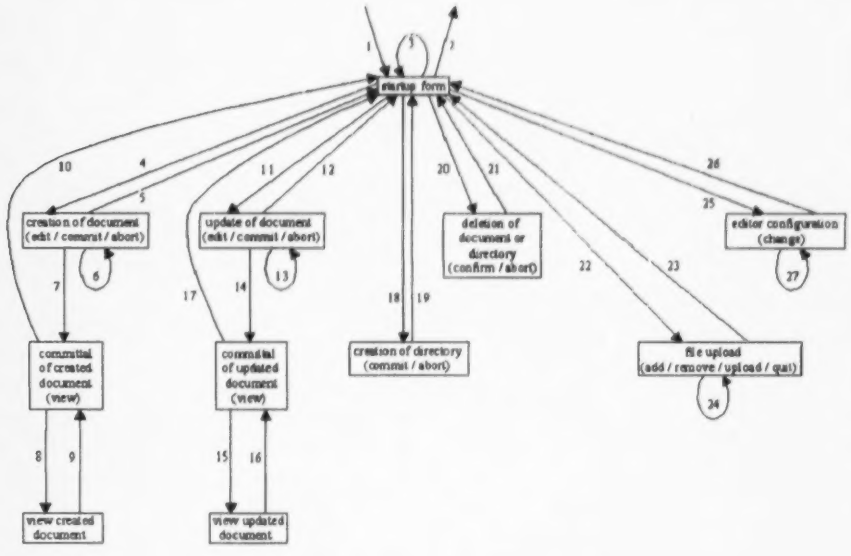
startup form
creation of document (edit / commit / abort)
update of document (edit / commit / abort)
deletion of document or directory (confirm / abort)
editor configuration (change)
commital of created document (view)
commital of updated document (view)
creation of directory (commit / abort)
file upload (add / remove / upload / quit)
view created document
view updated document

Figure 2: State transition diagram for DReSS 2.0.

1. start dress
2. "back" / "home" (quit dress)
3. clear fields / create document (already existing file or directory)/ update document (non-existing file or directory)
4. create document
5. abort / "back"
6. edit
7. commit
8. view
9. "back"
10. "back"
11. update document
12. abort / "back"
13. edit
14. commit
15. view
16. "back"
17. "back"
18. create directory
19. confirm / abort / "back"
20. delete document or directory
21. confirm / abort / "back"
22. upload file(s)
23. upload / quit
24. add / remove
25. configure editor
26. "back"
27. change editor

Table 1: Transitions

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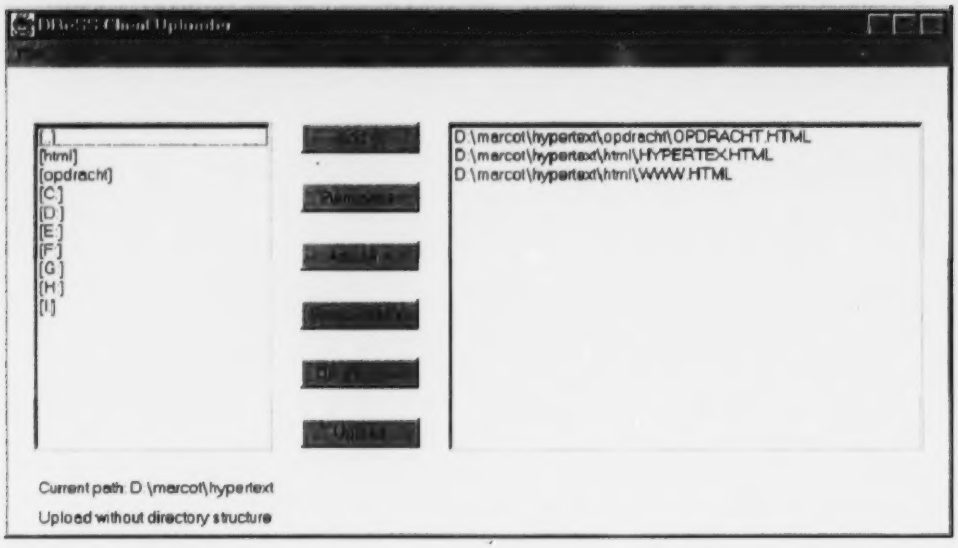

Figure 3: Client Uploader Interface

4. Application Issues for DReSS

4.1 Machine independence

The main problem we encountered in employing DReSS version 1.1 was the limited portability of the client helper programs. Despite the use of the standard WWW library from W3C it proved difficult to port the helpers to non-Unix systems. This prevented us from employing DReSS for its primary purpose: to enable students to upload assignment work for the hypermedia course 2L670 [De Bra 96]. A finished assignment is a hyperdocument of between 50 and 150 pages (files), so employing a single file upload system like BSCW was out of the question. To solve this problem, and to provide better file (or directory) browsing as well, the helper programs for DReSS 2.0 are written entirely in Java, which means that they should run unmodified on any platform that supports Java. (They have been tested on Windows'95 and Solaris, which are the platforms used by most of our students.)

In order to achieve machine independence on the server-side as well, the CGI-scripts for the document repository have been rewritten in Java. However, this does not result in a completely platform-independent solution, since CGI relies on the ability to pass environment variables from the Web server to the scripts, something which is not possible with Java programs from JDK version 1.1 onwards. (Reading environment variables has not only been marked deprecated but has been effectively removed from the Java support libraries.) The need for reading environment variables is circumvented by wrapping the CGI-scripts in a shell script. The needed shell script for Unix is different from the necessary "bat" file for Windows.

4.2 Groupware aspects

In the present configuration DReSS supports a limited form of groupware functionality, called information sharing [Gibbs 91], which is aimed at the use (and modification) of the same information by different people for performing knowledge intensive activities. BSCW, (and also Lotus Notes) offers an integrated message board, similar to HyperNews or WWWboard. For our courseware we decided to use HyperNews which was readily available, rather than developing yet another message board.

Lotus Notes supports replication of documents but does not offer an automated conflict resolution strategy for updates of the primary copy. In DReSS conflict prevention is realized by providing locks on documents currently being edited by one of the authors. Locking is done at the document level. In [Munk 96] we studied the use of an object oriented database for storing hypertext. The database replaces the file system, and the

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WWW-server is modified to store documents directly in the database. By using an object model for hyperdocuments which allows them to be decomposed according to their HTML-structure it becomes possible to access paragraphs or smaller parts in a document. Using the locking mechanism of the database system a more fine grained access to documents can be supported allowing different authors to work concurrently on different parts of the same document. Integration of DReSS with the OODB-based WWW-server is a project which will be started in the near future.

Recently we started another DReSS-related project: to combine DReSS with a Workflow Engine, based on the ExSpect (Executable Specification Tool) system [Somers 93] also developed at the Eindhoven University of Technology. This effort is part of an educational project aimed at student collaboration in a Software Engineering course. DReSS is used for sharing the deliverables of the assignment work for this course between members of a group of students who are jointly performing the assignment. The workflow engine is used to guard the orderly executions of the various activities of the project life cycle, and the timely delivery of the different required documents.

5. Conclusions

DReSS (in release 2.0) has evolved to a platform independent document repository system, through the use of standard protocols (RFC 1521 and 1876) and helper applications written in Java. The main advantages of DReSS over similar systems (like BSCW) are:

- **Simplicity**: DReSS is small and easy to install on most Web servers. It offers shared workspaces, to which users can upload documents, which can then be updated by a group of authors (but one at a time).
- **Hypertext Functionality**: DReSS is especially suited for applications where documents consist of many files, possibly connected by means of hypertext links. A whole set of files can be uploaded or downloaded at once.

In the near future we will be evaluating the use of DReSS as part of our hypermedia courseware. This evaluation will be used to further improve the user-interface and the dialog between user and system.

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Call-Us - Automatic Webpage Publishing System

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Abstract: This paper presents the proposal of a model to administrate WWW sites, focusing the communication between the users and the administrator. The main purpose is to minimize and to characterize the tasks involved in publishing Web pages. The prototype, called *CallUs*, of an automatic system of submission of pages for publication and request of services is presented, as well as the benefits of the proposal.

1 Introduction

Nowadays, many organizations are concerned with the publication of information via Internet Web pages. There are many issues to be addressed in this respect, such as the design and implementation of Web pages, the maintenance of servers and files, the interaction between the network/Internet administrator and users and so on. With the great development of information system and marketing groups in many companies, the design and implementation of Web pages are not network administrator tasks. As a result, many people in charge of developing Web pages are not computing expert. Therefore, they sometimes do not know what steps are involved in publishing their homepages, that is, they know how to build the pages, but they do not know how to make them available for the Internet. In this case, designers have to send the pages to the administrator and ask it to publish them.

Based on the scenerio above, we observe how important it is to have a direct relationship between the administrator and the users (Web page designers). This is possible in small companies, but it is not so easy when the company has many groups or departments.

In this paper we propose a model for Web page publication, focusing on the administrator-user relationship. This model can be applied to companies or groups of people with centralized Web administration and with distributed Web page development. Our case study was carried out at the Internet Management Group (LGSI), within the Global Campus Project witch is an agreement between PUCRS and IBM. The Internet Management Group is in charge of publishing almost all the Web pages of PUCRS Departments and we propose some automatic facilities to improve the communication (publishing) process. Thus the *CallUs* prototype will be presented in the description.

2 Case Study

Our case study is the process of publishing the official Web pages of PUCRS – an university with 50 departments and many administrative groups. This task involves many different people and is sometimes slow.

The Web page publishing process connected to PUCRS main Web page (PUCRS Web server) goes along the following steps: (1) the department establishes the first contact with the Web administrator (*webmaster*) to identify the resources available and the requirements; (2) one person in that department is nominated the manager of the department pages - this procedure creates a level of security; (3) the Web pages are designed and created by the user; (4) finally, the files are sent, via e-mail or floppy disks, to the administrator who manages the publishing process.

By analyzing all those steps we notice that the contact between the administrator and the users is a presential meeting instead of a virtual contact such as e-mail messages. After some time working on this kind of relationship, we found that many problems such as delays in publishing the pages, off-line updating of pages, change in users attitude towards the Internet and services such as ftp (file transfer protocol) as well as many repeated operations for the administrator had risen.

Therefore, we decided to group up the users into categories based on their knowledge and offer them a better way of publishing their pages. Moreover, we created a structured way of communication between administrator and users. The structure is based on some definitions: *dept*: it is the name given to any department or group that is allowed to publish a homepage in the PUCRS official Web page; *director*: is the head of the *dept*; *resp*: is the person (indicated by the *director*) that manages the *dept* page - he/she is the only one allowed to include, update and cancel the page; *webmaster*: is the Web server administrator

The first contact is between the *director* and the *webmaster* to establish an official entry in the system. After that, the *resp* is able to access the automatic publication system to include, update and cancel the *dept* page.

3 The System Proposed

The management of the site is made up by many tasks performed by one or more administrators. The tasks can be listed as follows: receiving the files with the Web pages; identifying their target (directory); testing the pages; creating the links; replacing some pages; canceling some pages temporarily; helping users with the implementation of their pages; managing the News groups; among many other more specific activities. Furthermore, since we found many tasks have to be performed repeatedly and each *dept* may ask for the same task many times according to the different requirements as shown above, the tasks were included in

the automatic publication system and the result is a different approach to the management of the communication between users and administrator.

From the administrator point of view, the pages can be managed in three ways: *no control*, *partial control* and *full control*. In *no control* schema the *dept* pages are fully controlled by the *dept*. Thus, the *webmaster* has *no* control over structure or contents (the webmaster only creates the link in the main page). In *partial control*, the pages are designed and implemented in the *dept* and the *webmaster* is in charge of uploading the pages to the server (main server or *dept* server) and creating the link in the main page. Finally, in *full control*, the pages are designed and implemented in the *dept* and the *webmaster* is in charge of uploading the pages to the main server, creating the link in the main page and managing the users requirements concerning disk space and others.

4 The *CallUs* Prototype

The model of an automatic publishing environment was implemented as a Web page that comprehends all the issues discussed in section 3. The main idea is to keep the first contact between the *director* and the *webmaster* to create an *UserId* and a *Password* that will give access to the automatic system - *CallUS*. This aims at reducing the direct contact between the *webmaster* and the user and all this can be done via the *CallUs* tool.

The *CallUs* page offers many options such as help systems, ways to manage their pages (in any modes - no control, partial control and full control) and News groups, ways to ask questions to the administrator. A manage page option allows the *resp* to upload the files, cancel the page for a period of time, change the structure, ask the administrator to change links or include new ones, change any information about the *dept* and so on.

The results of these requests are presented in three ways: an on-line answer in a Web page, an e-mail message to the *resp*, or a record in the Web server. All these operations are stored in log files to keep a record of the changes in that page.

The implementation of CallUs included HTML and CGI programming [KewÊ1997]. There are many electronic forms in the Web page to allow data input since the *resp* has to manage the *dept* page using the *CallUs* Web page. In order to perform the tasks, CGI programming which is the way to send information from the client (Browser) to the server was used. The programs were developed in Perl [AndrazaÊ1996; StocktonÊ1996] and C language in a SUN workstation.

Some important issues, such as security, quality and user friendliness were used. It is important to ensure that only authorized users can access the system. Users are happy with the system and the system is easy to use.

5 Final Comments

The project started in May 1997 and the first prototype was made available in August 1997. Since that time, the process of submitting Web page for publication has been done using *CallUs*. Since the system was introduced, 70 users at PUCRS University have been using it. As a consequence, most of the communications between the administrator and the users is accomplished via electronic mail and electronic form submitting. According to suggestions from users, new features have been added to the system, such as directory management and subgroup options.

Considering that the Internet is available to various kinds of users, we believe that it is extremely important to improve its usage conditions. As we are in charge of publishing Web pages from all departments in the University, our contribution to the improvement of Internet users environment was to introduce novel ways of communication between users and administrators.

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Tele-Learning in Graduate Education in Japan - Some Initial Results

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Abstract: As a result of the decline in the number of university students in Japan, universities are creating extensions located near major train and subway hubs, the "*ekimae daigaku*" ("university in front of the station"), permitting easy access to university training for those interested. This concept in now being extended to graduate studies for the first time in Japan by the Graduate Program in Information Management Sciences at Asahi University. Since the main campus of Asahi University is located far from the nearest large city (Nagoya), an extension facility has been set up near the Nagoya train-subway hub. This facility is connected to the main campus by an ISDN-based teleconferencing system together with Internet and Web access. The results of initial experiences with this system are reported. Finally, the authors discuss a number of the problems facing tele-learning in graduate education as well as some possible system modifications.

Graduate Education in Japan - Needs and Crisis

There is a state of crisis in graduate education in Japan in that the number of students is declining. In order to appeal both to full-time working students as well as to students enrolled full-time, the Graduate Program in Information Sciences at Asahi University was created. This program offers both the Master's as well as the doctoral degree in interdisciplinary fields covering telecommunications, multimedia communications, urban planning, economics, and so on. In order to accommodate working students as well as full-time students, night courses as well as courses on Saturday were introduced, perhaps a first in Japan at the graduate level. This gives the program the flexibility needed to handle such a potentially rich source of graduate students. Students working in full-time jobs account for about 90 % of the total graduate body at this time. However, the University's main campus is located in the countryside about thirty miles northwest of the major city of Nagoya in central Japan. Nagoya is the center of industry and commerce of that region, and most potential students live and work in nearby areas that permit easy access by subway or train to Nagoya, but require an additional travel burden to access the university. Japanese workers tend to work long hours and students often arise at the university after a long hard day at work as well as after a long trip by car or by public transportation. All these considerations have led to the creation of an extension facility in Nagoya located near the main train-subway hub of that city, hence easily accessible by those working in the Nagoya area. Indeed, there has been a recent trend in Japan of placing colleges and other specialized schools near such hubs, giving rise to the term "*ekimae daigaku*" or "university in front of the station." The case of the Asahi University facility in Nagoya is the first example, to the best of the authors' knowledge at least, of such a facility dedicated to graduate studies alone. This facility, called the Asahi University Nagoya Satellite (AUN), and the main campus are interconnected by an ISDN-based videoconferencing system and the University's intranet allowing internal and external firewall-protected Internet access.

The Asahi University Tele-Learning Facility

The University's tele-learning facility, inaugurated in the fall of 1997, uses an ISDN-based videoconferencing system as well as an intranet based system to interconnect a seminar room on the main campus and the AUN Satellite in Nagoya. In addition, several professors' offices and laboratories may connect to the system. The equipment configurations at the two sites consist of NTT's Phoenix workstations, Phoenix Wide equipment, Windows NT workstations, overhead projectors as well as standard fax machines and telephones. The overhead projector connects into the Phoenix Wide system, so one is able to display figures or text both locally and remotely. The Phoenix workstations are multimedia Windows 95 machines with Phoenix boards, speakers, cameras and

microphone. The cameras may be moved around manually and arranged as one wishes, as may the microphones. The Phoenix Wide equipment at each site consists of a large television screen and a desktop unit containing speakers, microphone and camera. Camera movement and focus are controlled by a hand-held remote control unit. A user may control the camera at his location as well as at the remote location. Two way connections are easily established, either for the Phoenix Wide or for the Phoenix workstation configurations. Both may be used at the same time. In the case of the Phoenix workstations, one may see the local site as well as the remote location in two separate screens. With the Phoenix Wide system, one may alternate between viewing the local and the remote sites. The sites are connected by ISDN BRI lines. The Windows NT machines are connected to the university's intranet with a gateway through a firewall to the Internet. An important consideration here is that in Japan, ISDN connectivity is virtually complete throughout the country and the costs are steadily declining, putting ISDN in the reach of the private citizen. For this reason, one might say that the approach towards tele-learning that has been adopted is a potentially inexpensive one using commercially available desktop videoconferencing systems and ISDN.

Initial Tele-Learning Trials at Asahi University

The system has been used rather extensively as an adjunct in teaching several graduate classes as well as for various administrative purposes, for example committee meetings with out-of-towners. In the graduate courses, the emphasis has been on creating an atmosphere conducive to the level of thought and reflection required by graduate studies and, in one case, to the use of the system in a bilingual English and Japanese mode. One of the graduate courses is conducted as an interactive seminar on multimedia systems in which the students are queried and encouraged to discuss certain points among themselves. Other courses are given in the more traditional professor speaks-student listens mode. In addition, the system has been used for remote consultations with graduate students on their Master's or doctoral work. The system is relatively easy to use. Since both cameras can be controlled both locally as well as remotely, there can be conflicts if both sides attempt moving one camera at the same time. But, with minimal preparation, the professor can indeed merely walk into the room and give his course in the modality described above. The physical configuration is critical for optimal use of the facility. Image quality of the Phoenix Wide system was marginally adequate, in fact, inadequate for regarding figures on the whiteboard and marginally adequate for images received from the projector. Voice quality was good, except that care had to be taken about room echoes. The system seemed in fact well adapted to the teaching modality of the courses offered. For large classes, the Phoenix Wide system would not be adequate unless substantial improvement were made to image quality, for example, by increasing the transmission bandwidth to 1.5 Mbps. For large classes, the large enrolment might cost-justify the additional expense.

Conclusions and Future Work

Essentially the initial experiences gained show that the satellite facility and the teleconferencing system certainly can be used effectively in dispensing graduate courses as described above. Equipment configuration is critical and more work must be done to determine optimal configurations. The facility can be used effectively now for students who cannot easily come to the main campus. Moreover, as ISDN costs continue to fall throughout Japan and accessibility to ISDN continues to increase, one might expect economies of scale to bring down the equipment prices even further, so that the kind of tele-learning system described in this paper may well become an economical and cost-effective means of offering distance education. Given the specific needs in graduate education for animated interactivity between the professor and his or her students and among the students themselves, the initial results obtained suggest that the kind of system described will be adequate. New equipment configurations and classroom configurations, together with economic feasibility analysis are now being carried out.

Acknowledgments

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Teaching Visual Communication Using the Web

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Abstract: The World Wide Web is an excellent medium for introducing general students to the elements and principles of visual communication and design. Issues which might have been too esoteric can be explored quite naturally in the context of Web publishing. We describe the rationale for and some of our experiences in conducting an unusual cross-disciplinary course in introductory computing and art. Students learn not only about the technology that supports the Web, but how to exploit the visual medium for communication.

Maximizing the Learning of Information Systems via World Wide Web

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As the Internet and World Wide Web find their place in the global community, they are revolutionizing the way people learn, entertain themselves and conduct business. Companies have realized the potential of these new technologies, turning them into vital conduits for training, information exchange and commerce. Unfortunately, our own discipline, which has laid the foundations for these advances, has failed to take full advantage of the benefits the Internet and World Wide Web offer IS teachers and students.

This presentation discusses how IS educators can revise their current course curricula to incorporate the resources of the Internet and World Wide Web by introducing a schematic model that details dynamic and static structures of Web-based learning environment. It focuses on building Web sites that present case studies. This encourages instructors to reexamine their current teaching methods and redesign their IS programs for their students. This also serves as an opportunity for an exchange of ideas on how to design new IS curriculum and/or the formation of an International IS Consortium for IS professionals.

Improving Lectures and Practical Classes in using an Automatically Feedback System

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Abstract: This paper presents an electronically feedback system for use in lectures and practical classes. The system itself is based on Java and provides a configurable feedback form, a managing tool for administrators and a statistic viewer for presenting the generated statistical data in various ways. In addition it generates a statistical history, which is an important instrument in comparing lectures and in tracing effects of improvements (or alterations) of the lecture. The paper shows how anonymity can be guarantee to the user and outlines the resulting problems. It concludes with possible improvements to prepare the system for a more general use.

1 Introduction

Because of today's big amount of students, teaching and working is, for both sides (tutors and students), hard effort. Materials are often that extensive, that lecturers can only teach parts out of it and only can help students in understanding the whole material. The more it is important to react to students' wishes and to understand their problems as early as possible. A crucial part of a lecturer's work is keeping contact to the students (during the lectures, office hours, email, news groups). In addition it is usual to use feedback forms to produce statistics over the lecture. On many universities (as in private companies) feedback is an important tool for comparing lectures and lecturers (or institutions). Ignoring this way of assessment is therefore not only a way of ignorance, it is also stupidity.

Usually at the end of semester feedback sheets are distributed and then again collected. With a one or two days effort (depending on the amount of students) all the forms are analysed and statistical data is generated. In most cases the data is not electronically stored and a comparison between different lectures is not possible. This approach has the following main disadvantages:

- too much time is needed for analysing the data,
- students are (generally) not informed about the results of the feedback,
- possible problems within the lecture are found *too* late.

It turns out, that only a few points should be altered which then is leading to an improvement of the lecture (see also [Lesgold 98]):

- the feedback should be analysed automatically,
- the data should be available electronically (for later evaluation),
- statistical history should be available,
- the data should be able to be accessed or entered from (nearly) everywhere,
- students should stay anonymous whenever possible (especially when entering feedback data),
- students should see the results of the feedback,
- feedback should be available as early as possible (during the lecture).

Finding solutions for that demands will lead to more motivated students, better lectures and less work for the lecturers. The system itself has to be that interesting, that both, students and lecturers, like to use it.
Statistical history is a powerful tool in tracing the development of lectures. As „Illustration is the basis of all cognition's" (Pestalozzi) graphical presentation of statistical data helps in understanding the results of the assessment and illustrates the (hopeful) improvement of the lecture.

This paper presents an approach of an electronically feedback system using the World Wide Web (WWW for short) and Java that is trying to fulfil all the demands listed above. The whole work is based on a project [Bollin, Luidolt 95] in 1995, where a feedback system was analysed using an object oriented approach (the Jacobson Method). With Java 1.0 (in 1996/97) it became possible to implement the system over the net and the first try run started in the winter term 1997/98.

2 Strategy for Improvement

At the beginning of the project our students had to fill out the feedback form in one of the last lectures of a term. The data was analysed and the results presented (and discussed) in the last lecture. Strongly motivated from the results of the discussion but stressed from the work of analysing hundreds of feedback forms our institute decided to provide a further service to the students: an *electronically* feedback form. In 1995 (based on the theoretical study of such a distributed system [Bollin, Luidolt 95]) we implemented parts of it in HTML and used CGI scripts to store the data. This system did not implement the system, as it was designed in 1995. There where two main disadvantages (leading to less motivation to use it):

- no feedback generated for the students,
- statistical data was not generated automatically.

As it turned out, the system was only used by a couple of students. Most of our students did not want to spent their time in filling out forms and saw no profit in using an electronically system. For short: it was not interesting to them. As our institute began to improve its services on the net and started to use an intelligent working environment [Bollin 97], the students became more motivated.

Motivation is the key factor for both, students and tutors. As common Internet browsers became able to run Java applets, we decided to implement the whole system using Java. The system then provided not only a feedback form, but also a viewer for students to display the statistical results of the feedback. With looking at the statistical history of a lecture every student is now able to trace the public mood in a lecture - which indeed is leading to more motivation. Using this approach we were able to increase the numbers of students using the system dramatically [Tab. 1].

	1995	1996	1997	1998
Feedback Sheets	130	119	112	108
Electronic Feedback	-	8	26	120
Students total	220	194	186	184

Table 1: Filled out feedback sheets and electronic feedback forms in the lecture „Informatik I" from 1995 to 1998.

As you can see in table 1 (which is including the trial run of our system in 1997/98) the new system provided much more motivation for students than the old version (with simple scripts in the background) or the paper version. In addition to the fact that analysing the data needed no time, students were highly satisfied with the possibility in looking at the results and used the system more often.

Another problem at the beginning was the scepticism in concern with anonymity. Filling out a feedback paper during the lecture (among hundreds of other students), looked much safer for most of the students. They seemed to be afraid that their opinion might influence their marks. Therefor we decided not to implement identification at the moment.

Every user is allowed to fill out the electronic feedback form, it is also possible to fill out the form more than only once. At the first glance this seems to be a problem, because one student could influence the statistics more than it is wished to, but on the other hand this kind of influence is, to a great extend, also possible with the paper form of the feedback. The problem could only be overcome with partial identification, which will be part of one of our next releases.

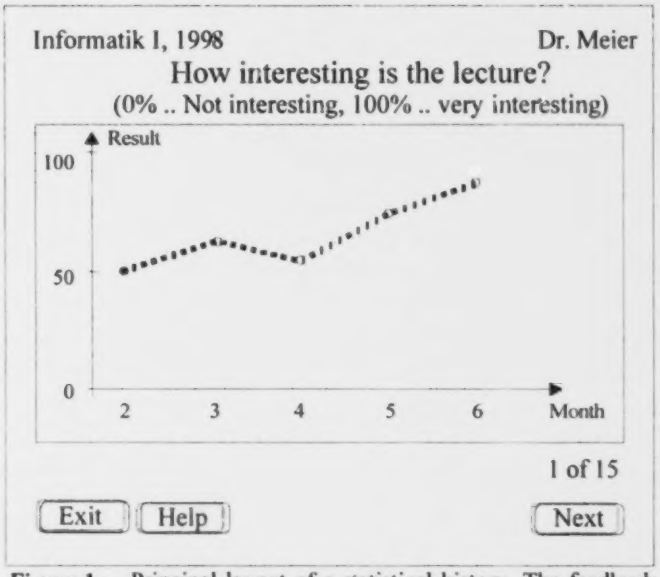

Figure 1: Principal layout of a statistical history. The feedback started in February - the history is displayed till the end of June

As mentioned above statistical history is a main factor for motivation. It is based on the fact, that feedback forms can (and should) be filled out throughout the whole lecture. The statistical history is then generated in the following manner:

1. the deadline is always the end of a month. The monthly summarising statistical data cannot be displayed for the running month,
2. the statistical data collected during the month is analysed and stored separately. This guarantees fast loading times and avoids time consuming computations,
3. the results of all months are summarised and can be displayed graphically.

Following this strategy, every month the data is collected and analysed. A lecture that starts in February and ends in June (five months) leads to six sets of statistical data - the average statistics of the whole lecture (which can be displayed at any time) and the statistics over every month (which can be displayed after the end of the first month). Displaying the results of a question (for example: „How interesting is the lecture?“) leads to a good representation of the mood during the lecture (see [Fig. 1]). This graphical interpretation of the mood during the lecture could be a good basis for tutors improving their lectures.

3 Design and Implementation of the Client

The latest version of our system is now fully based on the object oriented design and was implemented in Java JDK 1.0.2. We decided not to use JDK 1.1 to be sure, that our applets are also running on older versions of Internet browsers (like Netscape). The system is designed to be used across the Internet and therefor all class files are stored in a JAR (Java Archive) file, whose size is only 76 Kbytes. The JAR file together with a starting page now residues on our Hyper Wave Server [Kappe 93] and is accessible through the Internet (http://www.ist.tu-graz.ac.at/Feedback/Feedback.html).

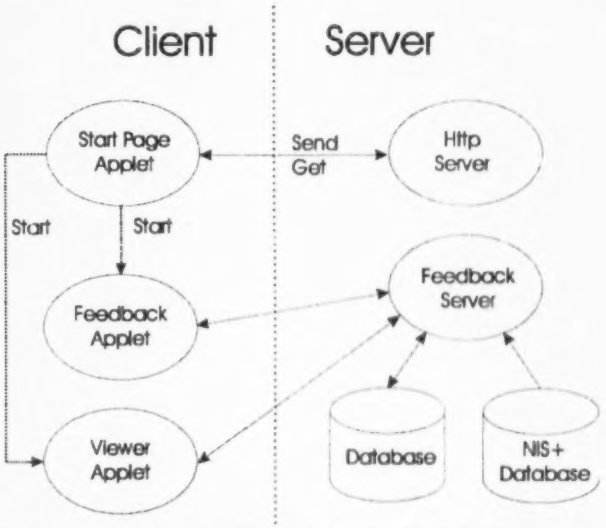

Figure 2: Principal structure of the feedback system. The feedback server has to run on the same machine as the http server, applets are started on demand.

At the moment the feedback system provides following functionality:

- feedback form for anonymous users. It provides an electronic implementation of a typical feedback sheet. The user is able to select a lecture and to fill out all or only some of the questions in the form. *No identification* is necessary to fill out the feedback form. At the moment there are two types of questions possible. Questions with radio buttons (one out of five: 0%, 25%, 50%, 75% and 100%) as a rating and questions with a textual entry field for answers or comments.

- viewer modes for anonymous and identified users. The viewer modes for anonymous and authorised users differ a little bit. Without identification every user is able to look at the statistical results. Anonymous users can get numerical and graphical feedback of a lecture and are able to trace its statistical history. The authorised user (the lecturer or tutor in praxis) has the same possibilities than the anonymous, but furthermore he is able to look at the comments and to browse through single feedback forms. This design decision guarantees, that private comments are not public to all students and students cannot see feedback forms in detail (which providing a higher level of anonymity).

- feedback administration across the net. As for authorised users a user name and password (encrypted) must be supplied. The administrator has the possibility to add, modify or remove lectures. Removing lectures is only possible after storing old statistical data to disk. Furthermore it is possible to administrate users and modify the feedback form. At the moment there is only one kind of feedback form, which means that the modification of the form leads to the modification of all forms of all lectures.

- on-line help available in every mode. It describes the functionality of the system and tells the users how to work with the system (filling in the form, browsing through statistical data or editing the feedback form).

The system itself consists of several Java classes, that are downloaded on demand (see [Fig.2]). At the beginning (browsing an index page that includes the „Start Page Applet") the user has the possibility to choose between filling out a feedback form („Feedback Applet") or to look at results of the feedback („Viewer Applet"). Depending on the user's choice, all necessary classes are downloaded from the http server and the applet tries to connect to the feedback server via sockets. For technical reasons (the standard security manager of Java that is implemented in common Internet browsers allows connections only to the computer, from where the applet comes from) the feedback server must residue on the same computer as the http server.

Every time the user wants to look at different data, a connection to the server is established, the needed data is transferred and then the connection is closed. This approach has two main advantages:

- it is not necessary to transfer the whole data to the client
- every time it is guaranteed that the user receives the latest information.

Every client uses commands for filtering out only that information that is needed for representation on the display. This guarantees short loading times and fast presentation of the data on the display.

4 Design and Implementation of the Feedback Server

Client and feedback server are using sockets for communication. We decided to use a simple (textual based) protocol for transferring commands and data. After a keyword a space is necessary, the hyphen is the semicolon. The server listens on a specified port till a connection is opened. It then starts a new process and resumes listening on the port. The new process now waits for a command, responds to it and then again waits for the next command. After a time-out (default is one minute after the last command) the server kills the process and closes the connection.

This strategy provides following advantages:

- the system is stable because old connections are at least closed after one minute
- the system is easy to debug,
- it is possible to implement textual based clients (GNU Emacs for example),
- the user always gets the latest data.

Some of the commands require prior identification. In this case the client has to send the user name and the encrypted password to the server. The server process then checks the password and changes the process status. User names and passwords can be stored by:

- using the server's database
- using network information services like NIS or NIS+

In addition to storing user names and passwords in the local database the server has the possibility to look up user names and passwords in local or global information systems. This is implemented by a configuration file, that specifies a way in accessing the local or global password database and describes how to filter out the full user name and (encrypted) password.

At the beginning of a new month the server process collects all the data from the last month, generates a statistical representation and stores it in the database. If a client wants to view the statistical history of a lecture

the server looks up in the database if such data is available. If he finds the data, he sends it to the client, otherwise he tells the client, that up to now no data is available.

5 Future Work

Though this version of our client runs without problems, there are a few things that we like to improved in the future:

- multiple feedback sheets,
- more kinds of question types,
- multilingual interface,
- different levels of identification,
- secure communication channel.

At the moment, only one standard form of feedback is supported. That means, that the feedback form is the same for all lectures (even after modifying the form). That is surely enough for universities where there exists one standard form for all lectures. When thinking about a universal use, different forms of feedback sheets should be possible. Analogue to this demand there should be more kinds of question types possible. Entry fields and radio buttons should be extended with check boxes, slide bars, graphical entry fields, or even a voice recorder. Universal use also implies the possibility of using different languages (not only German as in this version).

Another extension is the implementation of different levels of anonymity. As stated above, identification might be a problem for students. Nevertheless, to restrict the number of votes, identification is necessary. A three-level identification will be built into the next release (totally anonymous, registered but anonymous to the lecturer and identified). With identification encryption of the password is not enough. Feedback data is then sensitive data, so that using a secure connection will be necessary.

Even without all the improvements to our system the automatically feedback is surely of big help for students and lecturers. In times, when more and more work is done across the Internet, quality and motivation should always be of main interest - this electronic feedback system should be a brick in the wall of things that should be done to guarantee high quality in education and assessment.

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Teacher Training for Intranet-Internet Technologies in the Curriculum

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Abstract: Teachers from grades K-8 began a training process of effectively using computers in the curriculum which, when finished, will give them 150 hours of training. The most challenging part of the project is to produce profound results in the learning that occurs in classrooms and to be able to produce enough data to prove the efficacy of the new learning system. In order to accomplish these changes, we have decided to implement the training using the latest Internet-Intranet technology available. The main features of this Internet-Intranet technology is that it allows teachers to prepare students' activities and lessons on-line on the fly. Information is stored in a SQL database allowing immediate generation of reports and feedback for future training.

1. Introduction

The big challenge for school districts that have technology in place is to motivate teachers and students to use the latest technology in the learning process. A systematic and sustained training using Internet and Intranet technologies for teachers is one of the most efficient alternatives to change classrooms into 21st century learning centers.

Desert Sands Unified School District began to train its teachers in March, 1998. Teachers from grades K-3 were selected to begin the training process. Approximately 120 teachers from grades 4 - 8, and 12 more teachers from grades K-3, will begin the training process in September 1998. In two and a half years, teachers will complete 150 hours of training to effectively use computers in the curriculum. In the following years, 185 teachers from grades 4-8 will complete the training process. During the next four years, we will train over 350 teachers, grades K-8, in a systematic approach of incorporating computers into the classroom activities.

2. Project description

In order to motivate teachers to participate in training, each teacher will receive in exchange for their learning time a personal 233 MHZ MMX multimedia laptop computer. In addition if they agree to training, their classroom will be equipped with 4 networked multimedia 300 MHZ MMX computers and a 16-port 10/100 Mbs Switch.

In order to be effective, teachers will come to training for only 2.5 hours a week. The intent is to allow teachers time to assimilate the information they will receive in classes and to put that information into practice in their classrooms. They will become doers and not just listeners.

The most challenging part of the project is to produce profound results in the learning that occurs in classrooms and to be able to produce enough data to prove the efficacy of the new learning system. In order to accomplish these changes, we have decided to

implement the training using the latest Internet-Intranet technology available. The following is the format for the systematic training process:

1. The trainer will develop a set of activities that teachers will do in the training session using the Web Browser. Teachers will open the activities for the day and will submit their answers on-line. They will also submit their activity projects to the web page. Assignments for teachers for the next session will be related with concepts that they learned in the training session.
2. As part of the assignment, teachers will prepare a set of activities for their students using the same format that was used for their own training. Students of these teachers will do the activities in the classroom that their teachers prepared for them. All students' answers will be submitted on-line on the web page.
3. In order to understand the benefits of this approach, it is necessary to mention that all reports and information are stored in a SQL database server. All forms and on-line resources are located in the Intranet, securing the information from outside viewers. Students can access lesson plans only from their teacher, but teachers will have access to the bank of lesson plans created by their colleagues. Every teacher has a unique identification and students are correlated with their teacher's name.
4. One of the main advantages for the instructor who is participating in the staff development is the generation of reports that can link training activities that they do in training sessions to the results of their students. Because most of the activities that students will accomplish in the classroom are related to teachers' training, the information stored in the database will provide valuable information about the process.
5. The use of this stored information will provide the instructor with valuable information weekly which he/she can use to adjust the training in relation to the failures and successes of teachers as they are applying their learning. Instructors will have the opportunity to adjust their instruction according with to the results of students in actual classrooms.
6. The continuous training-feedback process for two and a half years will provide high quality training results.

Our condensed presentation of this in-progress project at the WEBnet98 conference will include the presence of at least two instructor-teachers who are participating in the project.

3. Summary

In summary, the project will develop one of the most unique ways of combining staff development and Web technologies to accomplish prominent results. Only with the availability of the Web technologies that we have in place today we can accomplish immediate feedback. This feedback from the effects of the training allows adjustment of instruction. The accumulation of all related data will provide more than sufficient proof of the winning combination of high-end technology applied to a structured training process. Students will be the winners!

Insight Through Experience: Hands-on Internet Experiments for Non-CS Majors

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ABSTRACT: We describe a series of lab exercises developed for an Internet course targeted at non-Computer Science majors. These hands-on experiments were designed as a means of providing concrete examples of how the Internet works. Our goal is that students should not merely acquire the skills to make effective use of the Internet, but should gain an understanding of the underlying concepts and principles.

Introduction

Recognizing that email and the web are essential tools for all college students, many colleges have introduced courses on the Internet for the general student. In developing a college-level course on the Internet, we are wary of designing a course that is narrowly focused on teaching skills. Rather than merely teaching our students how to use the Internet, our goal is to provide a conceptual understanding of the way the Internet works.

Students can more easily learn "how to" when they understand how and why these techniques work. Computer science in general, and the Internet in particular, is a rapidly changing field. The state-of-the-art tools of today are likely to become obsolete in the near future. Students who understand the principles involved will be better prepared to use new software as the technology evolves.

It is our responsibility to prepare our students to be informed citizens in a technological society. Social and ethical issues relating to the Internet cannot be fully addressed without a true understanding of the underlying technology. For example, a student who understands the way email software works can appreciate the ease with which email can be forged or tampered with. This student will be better prepared to analyze controversies regarding wiretapping and encryption.

Non-computer science majors require very concrete demonstrations and hands-on experience in order to understand concepts and principles. These students generally have had little computer experience, and have not developed the abstraction skills that computer science majors acquire through their program of study.

In this paper we describe a series of hands-on exercises that we developed to provide insight into how the Internet works. The experiments afford the students the opportunity to experience the way various protocols and software interact, transforming students from passive listeners to active explorers.

Background and Context

Brooklyn College has an undergraduate enrollment of about 10,000 students. The student body is diverse and reflects the City's many ethnic groups and socio-economic classes.

Our course, CIS 3, *The Internet,* is a two-hour lecture/ two-hour lab, three-credit course for non-Computer Science majors. Although students registered for this course are not expected to be computer-savvy, they all will have taken a one and a half credit of computer literacy course.

The course goes beyond the Internet-based Math/Computer literacy course described by [Gurwitz 97]. The course shares a treatment of HTML [Musiano & Kennedy 97] and JavaScript [Flanagan 97] with that described by [Mercuri et al. 97], but does not go as far in programming, opting instead to include forms, network concepts, ethics and the labs we describe below.

In developing the course, we were disappointed that we could not find a textbook that would serve our approach. We found that texts on the Internet tend to fall into two categories: highly technical books suitable for Computer Science majors, and very light "cookbook"-style texts targeted at non-CS majors.

Two notable exceptions are the books by [Comer 97] and [Lehnert 98]. Comer's book provides a non-technical explanation of the way the Internet works, but is lacking in terms of providing direction for further exploration. Lehnert's book (which we have adopted as the course text) is an excellent "how-to" book which includes many references and suggestions for hands-on learning.

Although Lehnert's book contains suggestions for many online exercises, these exercises are for the most part skills-based. For example, typical hands-on exercises are a Web scavenger hunt and design of a home page. These types of exercises should certainly be included in a course such as ours. However, our aim is to go beyond skills-based exercises and develop experiments that can provide insight into the nature of the Internet.

Our Environment

Brooklyn College has a campus LAN that connects a variety of PC labs and classrooms, Mac labs and classrooms, and Sun labs to each other and the Internet. All students received Unix accounts in one of the Sun labs for this course. Because these were non-majors, an extremely minimal but relatively gentle environment was created for them, one that allowed them to create, edit and manage files-- mostly so they could create web pages-- and have experience with the standard Unix mail client. From the perspective of the lab modules that are described below, the most important tool that the students had access to was telnet. The telnet tool was used by students to access their accounts from anywhere on campus. More significantly however, telnet can be used to open any TCP connection with a TCP server. The telnet user controls this by specifying the appropriate port number for the server to be contacted. Thus `telnet machine 25` contacts an SMTP server at `machine` whereas `telnet machine 80` contacts an HTTP server at `machine`.

Five Insightful Experiences

(1) Experiencing IP: The traceroute Experiment

At the heart of the Internet is IP, the protocol that among other services creates a virtual network that provides the illusion of direct point-to-point connectivity. To comprehend the Internet, appreciate its achievement, understand the nature of slowdowns, and recognize the complexity of certain social, legal and ethical issues, the illusion must occasionally be dropped. There is no better way of doing this in a concrete fashion than using the traceroute facility.

The traceroute ("tracert" in DOS) utility displays the path that a packet takes from the executing machine to a given IP address. Each hop (i.e. router) is shown along with additional timing information. A typical example of output is:

```
traceroute to www.aace.org (205.197.102.18), 30 hops max, 40 byte packets
    1  default (146.245.1.90)  0 ms  0 ms  0 ms
    2  146.245.3.9 (146.245.3.9)  2 ms  2 ms  2 ms
    ...
    9  sl-bb6-pen-6-0-0.sprintlink.net (144.228.60.21)  11 ms  21 ms  12 ms
   10       core4-hssi5-0.WestOrange.mci.net (206.157.77.105)  19 ms  40 ms  16
      ms
    ...
   13  nibbles.cstone.net (205.197.102.18)  139 ms  94 ms *
```

The output reveals the unseen part of the Internet, exposing an institutional complexity and technical virtuosity rarely appreciated by most users. Repeated use of traceroute reveals the dynamic character of the net, as timings and even routes change.

Following a demonstration of traceroute in the lab, students are invited to trace routes to their favorite web sites and note the differences. Although this demonstration/experience did make a big impression, we went further. We assigned our students the task of deducing as much as they could about the campus LAN topology by going from one lab or office (with permission) on campus to another, tracing internal routes.

BEST COPY AVAILABLE

Unfortunately, in many labs and offices, traceroute was unavailable; as a result, there were not enough obtainable routes to deduce the campus LAN technology. However, some deductions could be made and the better students greeted this task with enthusiasm and increased intuition about IP and routing. In the future, we plan to arrange for a greater number of points from which to do traceroute.

(2) Experiencing Client-Hood: Playing the Role Of An Email Client

If the Internet's heart is IP, then its soul is client-server computing. As casual users of the net, our students are frequently working with client software. Often they are aware of the existence of servers (thanks to messages informing them that the server is down or refusing their request). However, they have little sense of the nature of client-server computing and are only dimly aware of the distinction between different kinds of servers. Part of the goal of this lab module and the next is to correct this.

We start by showing students a live session of sending mail on a Unix system, with the -v switch turned on. What they see is something like:

```
louis (1) > mail -v arnow@its.brooklyn.cuny.edu
Subject: show off SMTP
here is the message
EOT
louis (1) > arnow@its.brooklyn.cuny.edu. Connecting to
atrium61.its.brooklyn.cuny.edu. via esmtp...
220 atrium61.its.brooklyn.cuny.edu ESMTP Sendmail 8.8.8/8.8.6; Tue, 3 Mar
1998 22:53:23 -0500 (EST)
>>> EHLO sci.brooklyn.cuny.edu
250-atrium61.its.brooklyn.cuny.edu Hello louis [146.245.1.7], pleased to ...
... additional lines from SMTP server displayed here
>>> MAIL From:<arnow@sci.brooklyn.cuny.edu> SIZE=95
250 <arnow@sci.brooklyn.cuny.edu>... Sender ok
>>> RCPT To:<arnow@its.brooklyn.cuny.edu>
250 <arnow@its.brooklyn.cuny.edu>... Recipient ok
>>> DATA
354 Enter mail, end with "." on a line by itself
>>> .
250 WAA07101 Message accepted for delivery
arnow@its.brooklyn.cuny.edu... Sent (WAA07101 Message accepted for delivery)
Closing connection to atrium61.its.brooklyn.cuny.edu.
>>> QUIT
221 atrium61.its.brooklyn.cuny.edu closing connection
```

What we see after the message is sent is the client reporting its TCP connection to the appropriate mail server and a transcript of its dialog -- using the SMTP protocol -- with that server. We provide a hardcopy of this to the students, clearly indicating the client's lines (boldface above). In the context of this demonstration we discuss the nature of client-server computing, protocol in general, and SMTP in particular.

Again, the key to reaching students is not to leave the topic with a demonstration but to give them hands-on experience. In this lab, they are to use telnet (on DOS or Unix) to contact the machine with the mail-server for the class on port number 25 and engage it in a client-server exchange. They are to use SMTP as a language with the goal of sending themselves email.

The second part of the lab is to recognize the possibility of sending faked email. Their task is to send mail to their instructor so that the header appears to come from their favorite fictional character or celebrity but with their own name in the message body so that they can get credit. As they work on this, the instructor's mail headers are continuously displayed on the overhead monitors and soon mail from the likes of BugsBunny from CartoonLand.org starts to appear.

The fake email lab provides a setting for a discussion on ethics in cyberspace [Baase 97]. It also generates a good deal of healthy skepticism regarding the automatic authenticity of Internet information.

(3) Experiencing Client-hood: Playing the Role of a Web Client

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In this exercise, students used telnet to establish a connection to HTTP servers. The protocol they used was much simpler than SMTP. They just had to send a line starting with "GET", a path specifying the resource, and the version of HTTP, all followed by a blank line. A typical interaction (student typing shown in bold) was

```
atrium15>telnet 146.245.2.68 80
Trying 146.245.2.68...
Connected to 146.245.2.68.
Escape character is '^]'.
GET /~arnow/index.html HTTP/1.0

HTTP/1.1 200 OK
Date: Tue, 03 Mar 1998 17:21:48 GMT
Server: Apache/1.2.5
Last-Modified: Mon, 13 Oct 1997 01:18:38 GMT
Content-Length: 1698
Accept-Ranges: bytes
Connection: close
Content-Type: text/html

<HTML>
<HEAD>
<TITLE>David Arnow's Home Page</TITLE>
</HEAD>
<BODY>
        <H1>David Arnow's Home Page</H1>
</BODY>
</HTML>
Connection closed by foreign host.
```

This experience again highlights the control-information/data-content duality of network communication and reveals a different kind of client-server relationship than the one they experienced exploring SMTP. Applying this to a web page that contains multiple images demonstrates another point that benefits from concrete experience: each web page displayed typically requires multiple repeated connections and HTTP interchanges. After this lab, the flurry of status bar messages seen in browsers became more understandable.

To enhance the lab experience, we arranged for the large overhead monitors to continuously display the last 20 lines of the access log file that the HTTP server maintained. As the various student web clients made contact, their information was displayed. We had earlier discussed the fact that an HTTP server may maintain access, referrer and error logs and had actually examined these files. However, the students were startled to see their own web activities instantly displayed on the monitor of a different machine. Novices apparently do not fully grasp the distributed character of the net without concrete demonstrations like this-- mere *use* of a web browser is too much like any other desktop computing experience.

In addition, students were intrigued by the "Big Brother" aspects of this. Again, we believe that although they all knew "in principle" that their web activities could be recorded in part, this aspect of web use isn't appreciated until they directly experience it for themselves.

(4) Experiencing Encryption: Using Pretty Good Privacy Encryption Software

Students who have completed a lab in which they sent fake email are eager to learn how safeguard against such forgeries. In this lab exercise, we illustrate the use of **PGP (Pretty Good Privacy)** software, which provides an implementation of double-key cryptography.

The first part of the lab is to have each student generate a key pair. When a key is to be generated, the user is offered a choice of security levels - low grade, high grade, and "military" grade. We ask different students to select different choices. The students requesting the higher security levels find that it takes more time for their keys to be generated than for the lower grade keys. This provides a concrete example of the tradeoff between tight security and fast execution time.

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The second step is to have the students clear sign a text file with their private key, and verify the signature. Then we ask the students to edit the file slightly - perhaps change only one word of the text - and then attempt to verify the signature of the tampered file. An abbreviated sample session is shown below:

```
atrium46> pgp -sat +clearsig=on testmessage
... Copyright notice displayed here
A secret key is required to make a signature...
You need a pass phrase to unlock your RSA secret key.
Key for user ID "Chaya Gurwitz <gurwitz@sci.brooklyn.cuny.edu>"
Enter pass phrase: Pass phrase is good.
Key for user ID "Chaya Gurwitz <gurwitz@sci.brooklyn.cuny.edu>"
1024-bit key, Key ID F8AAB131, created 1998/02/25
Clear signature file: testmessage.asc
atrium46> more testmessage.asc
-----BEGIN PGP SIGNED MESSAGE-----
            This is a test of PGP software.
-----BEGIN PGP SIGNATURE-----
Version: 2.6.2
iQCVAwUBNPzufbemED34qrExAQGkTwP/XU/KowN/bzb3MvfjGzCRdxNeCjLhsdgy
5KgUg/2gIZyzOn8oaJgKfx+dMaKagNvlQaY+CHBvRwfnhkAUoq0SiqD2gBdkDxRB
m/m3KO/h+RyXYTjqL5dgBkismpPL9v0cPhfB/Xi4ONF7JthfaU9Auwome+17BP0r
4eEhjj1rRWY=
=c0Ks
-----END PGP SIGNATURE-----
atrium46> pgp testmessage.asc
... Copyright notice displayed here
File has signature.  Public key is required to check signature. .
Good signature from user "Chaya Gurwitz <gurwitz@sci.brooklyn.cuny.edu>".
Signature made 1998/03/04 06:03 GMT
Plaintext filename: testmessage
atrium46> vi testmessage.asc
atrium46> more testmessage.asc
-----BEGIN PGP SIGNED MESSAGE-----
            This isn't a test of PGP software.
-----BEGIN PGP SIGNATURE-----
... PGP signature displayed here
-----END PGP SIGNATURE-----
atrium46> pgp testmessage.asc
... Copyright notice displayed here
File has signature.  Public key is required to check signature. .
WARNING: Bad signature, doesn't match file contents!
Bad signature from user "Chaya Gurwitz <gurwitz@sci.brooklyn.cuny.edu>".
Signature made 1998/03/04 06:03 GMT
```

A naive user might be amazed when the verification fails -- after all, he may realize that he wouldn't have been able to detect the change on his own!

The final step involves verifying email coming from the instructor. We post our public key and have the students add that key to their virtual key ring. Then we send a series of email messages, some authentic and some not, and have the students determine which messages are legitimate.

The PGP lab naturally ties in to a discussion of the controversy over digital wiretapping and attempts by the government to limit the use of cryptography [Baase 97]. These issues relate to the broader conflict between individuals' rights to privacy and government's need for access to privileged information.

(5) Experiencing Cookies

Whether because of their whimsical name or the discomfort of having external entities modify one's computer, students and Internet users in general have a fascination with cookies. In this module, we leveraged the work the class did with forms and JavaScript so that each student could set cookies and then discover the cookies their machine was providing.

Setting cookies is easy in JavaScript. It simply involves assigning a long string to `document.cookie`:

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```
<SCRIPT LANGUAGE=JAVASCRIPT>
<!--
   document.cookie = "food=junk; domain=acc6.its.brooklyn.cuny.edu; \
                      path=/~arnow; expires=Wednesday, 23-Dec-98 00:00:00 GMT;
"
// -->
</SCRIPT>
```

The string consists of a name-value pair which is the content of the cookie, an expiration date, and two fields, domain and path, that control which web pages can receive the cookie. No web page outside the indicated domain will get the cookie. Furthermore, the string following "path", in this case "/~arnow" prevents any web page whose path does not start with "/~arnow" from receiving the cookie. Thus, in the case above, only web pages on the server acc6.its.brooklyn.cuny.edu and within user arnow's web pages will receive the "food=junk" cookie.

Reading cookies in JavaScript is complicated and beyond the scope of the class. Reading cookies is easy in CGI, but the students were not allowed to write server-side scripts. We therefore provided a simple CGI script that students could reference in the ACTION field of a form as a means to discover the cookies their browser is sending:

```
#! /bin/sh
# showcookie CGI script
echo "Content-type: text/html"
echo
echo "cookies received = $HTTP_COOKIE"
```

Students could include a minimal form in a web page to activate this script with a submit button:

```
<FORM ACTION=http://acc6.its.brooklyn.cuny.edu:/cgi-bin/showcookie
      METHOD="POST">
    <INPUT TYPE="submit">
</FORM>
```

With this apparatus in place, the fun and the insight begins. The key point for the student to see is that the domain and path fields control the circumstances under which the cookie is sent back. Changing path to "/~studentA" prevents the cookie from being sent when the web page belongs to studentB. Students readily could verify this by accessing each other's showcookie pages.

Unlike the other exercises, this exercise demonstrated that there is "less than meets the eye". This demystification is as necessary as the four ones above-- and is appreciated by at least some of the students.

Summary/Conclusion

The experiments described here are easy to incorporate into an Internet course. Our experience has been that students are intrigued by these labs and find them the most interesting part of the course. The hands-on activities enhance their absorption of the lecture material. We feel that these experiments illuminate some of the inner workings of the Internet and that our students gain a firmer understanding of the Internet than they would from either a purely skills-oriented course or even an Internet-programming (e.g. JavaScript) course.

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Agents to Make Your Information Meaningful and Visible: An Agent-Based Visual Information Management System

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Abstract: The topic of the reported research concerns how the overall information management task is split into several sub-tasks that are distributed among team of information agents. We aim to design an architecture of a distributed agent-based system allowing co-ordination and communication between single agent entities according to the main tasks involved in information management. The work is based on a generic way of structuring the information, based upon conceptual mapping of the information domain. We model the relationships between attractive user-oriented visualisation of information and information structures and the effectiveness of information retrieval, search, and usage by users. In respect to these objectives a small system prototype, called AIMS - an Agent-based Information Management System, is under development.

1. Introduction

There are number of problems encountered in respect to the task of searching and finding relevant information in large scale information contexts. Some of them concern complexity of human-computer interaction, unstructured and dynamic searchable information, dominant mode (textual) of its presentation, lack of effective information management tools and support of collaboration in Information Search and Use (ISU) task. Due to these factors, the ISU task as situated in the Internet context involves extreme complexity.

Our research is purposed to find possible directions for overcoming the problems as mentioned. When discussing ways of solving them we do not consider a single-item technique, but a combination of methods and techniques in order to provide an integrated solution. This paper discusses some findings resulting from our research in respect to problem solving potential of combination of several technologies, like knowledge representation, automated-learning, graphical representation and visualisation, user modelling, collaborative work support, and agent-based technology. This could result in the construction of flexible, adaptive, user-oriented information management environments.

2. AIMS: Main Design Principles

Our paper discusses work in progress related to the design and development of an Agent-based Visual Information Management System (AIMS). It is resulting from several research projects involving the Department of Educational Science and Technology at University of Twente, The Netherlands, and the Department of Information Technology at the University of Sofia, Bulgaria.

The main design principle is based upon the 3A (Accessibility, Adaptation, Attractiveness) approach to organisational memory [Aroyo, De Diana, Diakov 98]. We do not conceive information manipulation as the mere application of simple search engines to collections of information items, but as a task that necessitates a concise system architecture bringing together the main functional modules for manipulating collections of resources situated within a knowledge- and information sharing environment. A 3-dimentional architectural framework is applied employing multi-agent support for intelligent information manipulation over a visual

representation of the information domain, and a conceptual organisation of resources involving semantic mapping techniques.

3. General System Architecture and Main System Modules

The main activities in AIMS are carried out by agent modules based upon theoretical and empirical results of current agents research [Maes 94, Mueller 96, Wooldridge, Jennings 95]. The system architecture is presented in [Fig1].

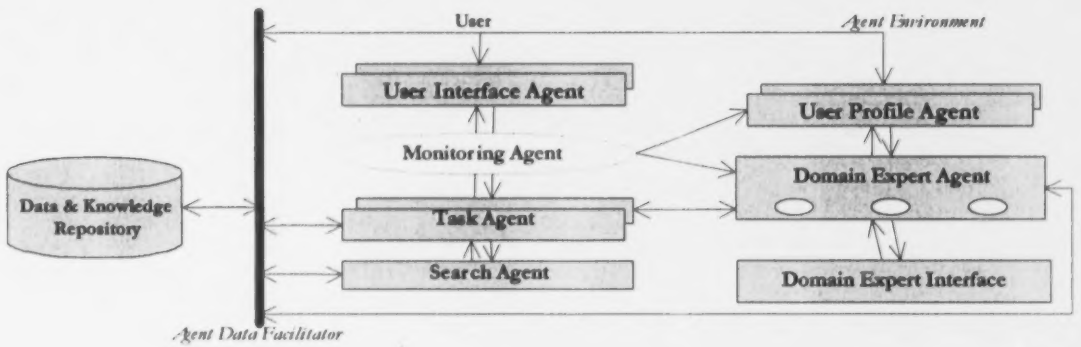

Figure 1: AIMS General Architecture.

The objective of the *search abilities* is to allow for mapping between users' specified needs and the items in the information domain that could be answers to the need. The Search Agent performs intelligent search activities over the given information domain by receiving well specified queries and finding the relevant documents. The working algorithm is based on relations among documents, keywords, synonyms, and domain terms.

The main goals for embedding *visualisation techniques* within AIMS are to facilitate the users' comprehension and to provide means for easy navigation and manipulation of large amounts of information by a conceptual knowledge-based structuring and organisation [Donald 83], and to provide an easy manipulating overview of search results, information domain and terms with their conceptual relations. that can make the search process more efficient for the user (VUI, Conceptual Dimensions, Inc.). The User Interface Agent in AIMS takes care of the direct system-user communication.

Our approach to *user modelling* is mainly based on observing users' actions (in interaction with the system) and collecting system and user information that is afterwards transformed into the system's knowledge about the user.

4. Conclusions and future perspectives

Future perspectives are aimed at development of functions that can assist users in finding valid and relevant answers to queries, coupled with the potential for application of answers to those queries in multilingual environments and not in the last place- the development of tools to support information visualisation. In respect to visualisation one of the prime issues is advanced adaptability of the user interface and related information presentation.

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Using Databases for Dynamic Web Sites: Tools

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Abstract: There is currently a strong interest in web database tools for building web applications, particularly dynamic web sites. This paper briefly discusses the advantages and disadvantages of three major classes of web database solutions -- CGI, server-side programming languages (APIs), and database tools with built-in web capabilities. In general, server-side programming languages are the most cost-effective solution for moderately-sized applications.

Types of Web Database Tools

One of the hottest topics in the Internet development community in recent months is web-enabled or web-based databases (Spitzer, 1997). It is no accident that this rise in popularity coincides with the increase in industry and business use of the inter- and intranet. The largest single type of business and enterprise computing application is client-server database transactions — this need is driving the production of a wide variety of web tools for interfacing with and controlling databases. Though the majority of these tools are designed for traditional database tasks in the corporate environment such as data entry and retrieval, they also provide the opportunity to fundamentally change the way websites are produced, managed, and delivered (Yang, et. al., 1996). This paper will discuss the tools that can be used with databases to dynamically manipulate web pages.

There are three basic methods for integrating databases with the web: Common Gateway Interface (CGI)-based scripting; server-specific application programming interface (API) programming; and publishing capabilities and plug-ins for data-oriented products. Each of these approaches has a different balance of costs, reliability, portability, as well as effort on the part of the designer(s). The underlying assumption is that the benefits of database-web interfaces is worth the trouble!

CGI is the standard method of interfacing a HTTP server with an external program. Theses external programs are normally some sort of script, commonly written in Perl. CGI can also interface with compiled programs in a languages such as C and Java. The major advantage of CGI is that it is a standard feature of all HTTP servers; it's a viable solution on all web servers and requires no special software to make it work. Another advantage is that there is are literally thousands of public domain Perl scripts for CGI available online. The biggest disadvantage is that executing a CGI program requires a significant amount of the server's resources, a situation that can lead to serious performance problems if the script is commonly accessed by multiple users. It also requires knowing a programming language and having some facility with server software.

Despite the disadvantages of CGI, it remains a popular method of interfacing databases and the web. The databases are typically flat text files that are accessed through text-processing scripts. Perl is the language of choice for text processing, with Python also offering advantages for text databases. A public domain UNIX database, mSQL, is a more sophisticated solution that interfaces with the web through CGI. Neither method is particularly applicable to existing databases or causal users.

The problems with CGI, particularly the performance issue, has been addressed by several server manufacturers through the development of application programming interfaces (API) for their server products. A server API allows clients such as web browsers to interface directly with the server instead of an external program. They typically work with any ODBC-compliant database, which covers the range from access to Microsoft SQL server to high-end Oracle databases. This has the advantage of increasing the speed that the server can respond to data requests, especially in multi-user systems. The biggest disadvantage is that these methods are server-specific, so programs can't be shared between platforms. Netscape (NSAPI), O'Reilley

(WSAPI), and Microsoft (ISAPI) have all developed their own incompatible frameworks to handle a variety of server tasks, including database access.

One distinct advantage of using a server with a data-enabled API is that third-party tools exist to help create applications that use the server API. Cold Fusion (Hightower, 1997) is a superb database interface tool that rapidly decreases the amount of time it takes to develop web-based applications. Microsoft's Internet Database Connector (IDC) (Dobson, 1996) and ActiveServer Pages are also tools that make it easier to develop applications using server APIs. Writing applications that take advantage of APIs directly is beyond the capabilities of most casual programmers, so third-party tools such as these provide an excellent way to create high performance web sites at a moderate cost.

The most intriguing, most expensive, and most powerful solutions to web databases probably are the enterprise-level, object-oriented database products (Davis, 1996) from such manufactures as Netdynamics, Oracle, and Informix (McKenzie, 1996). Object-oriented databases are well-suited to the web since there are many types of media other than text that can be stored in web databases. Many of the existing large-scale database products have been extending their capabilities or designing new products to meet the needs of dynamic websites (White, 1996). These products are robust, especially in multi-user systems and can be adapted to virtually any task, but they are very expensive. They also require a significant investment in manpower and obviously the programming and development work is not portable to other platforms. Another interesting feature of this type of solution in that the data is central to the tool, and the web is simply treated as a way to display or publish that data; the other approaches to web databases put the web at the center of the effort with the data in a supporting role.

Conclusions

It is clear that databases and the web are clearly a useful combination of computer technology (Hadjiefthymiades, 1996); the real question is what tool to use to implement that connection. From the preceding discussion, it is clear that the appropriate solution is most dependent on the database traffic on the website and the technical capabilities of the support staff. In most moderately sized applications, a casual programmer can learn to use a third-party, API-based tool to create web-based web applications. These tasks are also fairly modularized, so they can be outsourced for modest initial cost and low maintenance overhead. Individual, low-use, and budget applications can make use of public-domain CGI scripts for effective, if not high-performance, data access. The high-end solutions are only appropriate for institutional-level commitment of time, money, and personnel. Since effective solutions exist for all project sizes and budgets, there is no reason for not incorporating dynamic data-delivery into any website today.

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Categorisation by Context

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Abstract

Assistance in retrieving of documents on the World Wide Web is provided either by search engines, through keyword based queries, or by catalogues, which organise documents into hierarchical collections. Maintaining catalogues manually is becoming increasingly difficult due to the sheer amount of material, and therefore it will be necessary to resort to techniques for automatic classification of documents. Classification is traditionally performed by extracting information for indexing a document from the document itself. The paper describes the technique of categorisation by context, which exploits the context perceivable from the structure of HTML documents to extract useful information for classifying the documents they refer to. We present the results of experiments with a preliminary implementation of the technique.

1. Introduction

Most Web search engines (e.g. Altavista™, HotBot™, Excite™) perform search based on the content of documents and provide results as a linear list of such documents, typically ranked in order of relevance. The often unsatisfactory aspect of this approach is that the list can be quite long, with many replications, and without any indication of possible grouping of related material. For instance, issuing a query with the keyword "garbage", one would obtain a list of documents that discuss ecological issues interspersed with documents about garbage collection in programming languages. Splitting the list of retrieved documents into thematic categories would significantly facilitate selecting those documents of more interest to the user.

Notable exceptions to this approach are Lycos™ and Yahoo™, which maintain a categorisation of part of their search material. Actually Yahoo gave up its general search service in favour of Altavista and supports only searches within its own catalogue. This allows a more focused search restricted to the documents within a given category and also the results of a query are presented arranged within subcategories.

However both Lycos and Yahoo are based on manual categorisation of documents performed by a small set of well-trained categorisation technicians (even though Lycos™ recently announced the development of an automatic classifier).

It is questionable whether manual classification will be able to scale well with the growth of the Web, which will reportedly reach over 30 terabytes within 2 years, a size larger than the whole US Library of Congress.

First, manual classification is slow and expensive, since it relies on skilled manpower. Second, categorisation is quite a subjective task and the consistency of categorisation is hard to maintain when several human classifiers are involved.

Finally, the task of defining the categories to use (hereafter called *catalogue*) is also difficult and subjective, and new categories emerge continuously in many domains. For example, documents relating to ActiveX technology might fall within operating systems or within graphics or within object-oriented programming. None of these categorisations would be satisfactory, since each of them would miss to establish close connections with other related technologies, like CORBA, JavaBeans, etc. In this case it seems that a new category is emerging ("Software Components") which is not currently envisaged. In fact, by browsing the Web, we may discover several pages that contain references to documents relating to these subjects: each such page in fact determines a context for these documents. These contexts can be exploited for creating the appropriate category and to discriminate between documents falling within different categories.

A similar problem arises in the organisation of personal material, for instance mail and bookmarks [Maarek 96, Weiss 96].

In this paper we investigate a novel technique for *automatic* categorisation, which may be dubbed *categorisation by context*, since it exploits the context surrounding a link in an HTML document to extract useful information for categorising the document it refers to. Combining contextual hints from several documents, a high degree of accuracy can be achieved. This technique is complementary to the traditional technique of *categorisation by content* [Ng 97], which extracts information for categorising a document from the document itself. Such approach may exploit linguistic analysis to determine relevant portions of the text [Fuhr 91] and then it exploits probabilistic or statistical analysis to perform feature selection and to weight selected features.

A significant advantage of context-based indexing categorisation is that it can be applied to multimedia material, including images, audio and video [Shrihari 95], since it does not depend on the ability to analyse and index by content the documents to be categorised.

Furthermore, the mechanism that we will describe can be used to restructure a catalogue: in fact classification is performed with respect to a base catalogue hierarchy. Therefore, supplying a different catalogue hierarchy will produce a new categorisation. This is quite useful in the non-infrequent case when one discovers that a certain catalogue is no longer appropriate. With other techniques, manual or automatic, re-categorisation of a document set according to a different catalogue requires significant effort and one tries to avoid it. The technique of categorisation by context provides an automatic tool for doing it.

Categorisation by context leverages on the categorisation activity that users implicitly perform when they place or refer documents on the Web, turning categorisation, form an activity delegated to a restricted number of specialists, into a collaborative effort of a community of users. By restricting the analysis to the documents used by a group of people, one can build a categorisation that is tuned to the need of that group.

2. Related Work

Hypertext links pointing to the document to be categorised have not been used so far for categorisation, although they have been used as clues for searching documents [Chalmers 98], and for measuring the "importance" of a Web site [Brin 98].

Vistabar [Marais 97] is a desktop assistant for Web browsing that provides also a categorisation tool, which uses the Yahoo™ classification hierarchy. A category profile is precomputed for each category in Yahoo and Vistabar performs a traditional vector space matching on the weighted word frequencies of a document relative to the corpus, exploiting however the hierarchy of categorisation to prune the search. Vistabar also allows sharing categorisation and annotations by a group of users.

Automatic categorisation is the approach used by Northern Light in their new search service, which dynamically organises search results, creating Custom Search Folders™ of documents with similar subjects, sources, or types. Within each folder a new subset of the original result list is produced containing only more focused results.

Contextual information is exploited in ARC [Chakrabarti 98], a system for automatically compiling a list of authoritative Web resources on a topic.

3. Architecture

The technique of categorisation by context consists in extracting contextual information about documents by analysing the structure of Web documents that refer to them. The overall architecture of the task of categorisation by context is described in [Fig. 1], and consists in spidering Web documents, HTML structure analysis, URL categorisation, weight combination and catalogue update.

3.1 Spidering and HTML Structure Analysis

This task starts from list of URLs, retrieves each document, analyses the structure of the document expressed in terms of its HTML tags. For an introduction to HTML we refer to the HTML Primer [HTML].

The tags considered are currently: <TITLE>, <Hn>, <UL>, <DL>, <OL>, <A>. Whenever one of these tags is found, a context phrase is recorded, which consists of the title within a pair <H*n*> </H*n*>, or the first portion of text after a <UL> or <DL> tag, or the phrase within a <A> tag. When a <A> tag is found containing an URL, an *URL Context Path* (URL: C_1: C_2: ... : C_n) is produced, which consists of the sequence of the context strings so far (C_1: C_2: ... : C_n) associated to the URL. Therefore C_1 is the text in the anchor of the URL, and the other C_i are the enclosing contexts in nesting order.

In the analysis tags related to layout or emphasis (<EM>, <B>, <CENTER>, <FONT> etc.) are discarded.

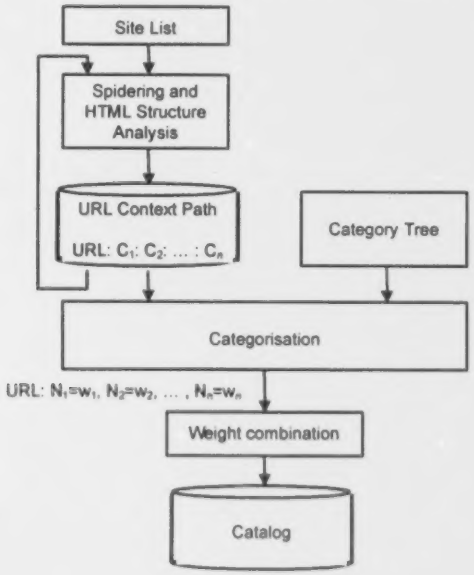

Figure 1: Architecture of Categorisation by Context

Another possible element for a context is the title of a column or row in a table: tag <TH>. Such title can be effectively used as a context for the elements in the corresponding column or row.

For example, consider the following fragment of an HTML page from Yahoo™!:

```
<html>
<head><title>Yahoo! - Science:Biology</title></head>
...
<li>
<a href="http://esg-www.mit.edu:8001/esgbio/">
M.I.T. Biology Hypertextbook</a> - introductory resource including information on chemistry, biochemistry, genetics, cell
and molecular biology, and immunology.
<li>
<a href="http://muse.bio.cornell.edu/">Biodiversity and Biological Collections</a>
 - information about specimens in biological collections, taxonomic authority files, directories of biologists, reports by
various standards bodies, and more.
...
</html>
```

the following context paths are created:

```
http://esg-www.mit.edu8001/esgbio:
    "M.I.T. Biology Hypertextbook" :
        "introductory resource including information on chemistry, biochemistry, genetics, cell and molecular biology, and
        immunology" :
            "Yahoo! - Science:Biology"

http://muse.bio.cornell.edu:
    "Biodiversity and Biological Collections"
        "information about specimens in biological collections, taxonomic authority files, directories of biologists, reports by
        various standards bodies, and more"
            "Yahoo! - Science:Biology" :
```

Any URL found during the analysis is passed back to the spidering process, if it points to a document within the current site and stored for later analysis if it points to an external site. This allows us to perform a depth-first visit of a site, collecting any categorisation information it contains about itself and other sites.

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3.2 Categorisation

The categorisation task exploits the database of URL *Context Path* and the *Category Tree* within which the URL must be categorised. The Category Tree consists of a tree, where each node contains a *title*, i.e. a single word or phrase, which identifies the category.

The goal of the categorisation is to find the most appropriate categories under which an URL should be categorised. The output of the categorisation is a sequence of weights associated to each node in the Category Tree:

URL: $N_1=w_1, N_2=w_2, \ldots, N_n=w_n$

Each weight w_i represents a degree of confidence that the URL should belong to the category represented by node N_i.

The weights from the Context Path for a URL are added with all other Context Paths for the same URL and normalised. If the weight for a node is greater than a certain threshold, the URL is categorised under that node.

The mechanism should allow for categorising an URL under more than one node, but never in two nodes which are descendant of one another.

4. Algorithm

The categorisation algorithm considers each node in the Category Tree as a path. For instance, a subset of the Arianna category tree (Arianna is a search engine for the Italian Web space that we are using for our experiments) corresponds to the following paths, translated into English:

Business and Finance: Insurance	Computer: Sale
Business and Finance: Associations	Computer: Distribution
Business and Finance: Banks	Computer: Events
Business and Finance: Events	Computer: Fairs
Business and Finance: Fairs	Computer: Schools
Business and Finance: News	Computer: Courses
Business and Finance: Services	Computer: Associations
Business and Finance: Companies	Computer: Software
Business and Finance: Publications	Computer: Hardware
Business and Finance: Schools	Computer: Telecommunications

Notice that the term Events appears in several categories, therefore the title of a category is not sufficient to identify the category: the whole path is necessary to disambiguate among the categories.

The categorisation algorithm works as follows: for categorising an URL it computes first a vector of matching weights for each path in the Category Tree, then it determines the paths with the best matching vectors, and finally it updates the catalogue.

4.1 Computing path match vectors

Given an URL context path (URL: C_1: C_2: ... : C_n), the algorithm considers in turn each C_l, starting from C_1. To each level we associate a weight d_l, decreasing from $C_1 = 1$, for instance with a value $1/log_2(n-1)$. It may be worthwhile to adapt these weights take into account the significance of a tag, for instance a <TITLE> tag may have a slightly higher weight than its position would imply.

Then we extract from C_l the noun phrases $n_0, \ldots, n_k$ it contains. For each path p in the Category Tree, we create a path match vector pv with as many fields as the path length, initialised to 0.

Each phrase n_i is matched against each title in each path. If there is a match between n_i and the title of category in the k-th position in path p, with matching weight mw_i, then $d_l \times mw_i$ is added to pv_k. This process is repeated for each level $1 < l < n$.

Notice that since there can be several matching, the value in a field of a path match vector can be greater than one; therefore these values are normalised before performing comparisons.

To compute matching weights, we exploit several tools and data structures. To extract noun phrases from contexts we currently use LTPOS [Mikheev 98], a lexicon-based part of speech (POS) tagger with a stochastic disambiguator. A POS tagger like LTPOS is essential, since the lexical information provided by WordNet is not sufficient to determine the proper meaning and role of a word in the context of a phrase.

Since it is unlikely that noun phrases use the exact terms present in the titles, we must widen somewhat the search. In order to do this we precompute a neighbourhood of words for each term in a title, exploiting information from WordNet, which we store in an inverse neighbourhood table.

Matching a noun phrase with a title, which in general is also a noun phrase, requires matching multiple words. For each word from right to left in a noun phrase we compute the matching weight with a neighbour word in a title. We compute *mw*, as the average of all such weights for a series of words that compose a full title.

4.2 Selecting best matching categories

Any path match vector *pv* that contains non-zero fields is considered as a *potential candidate*. The selection among these candidates is performed as follows:

1. discard any path with 0's in its leading fields. This means that that we found matches only in some subcategory but not in the top-level categories. For instance an URL relating to a business event we matched Events, but not Sports. The URL in fact will match both categories Business and Event in the Business:Event path.
2. among candidates with similar overall score, select the one with longer path. This forces categorisation under the most specific category.

The selected estimate records are stored in the database, associated to the URL. When the same URL is reached form a different path, the new estimates are combined to the previous ones. This will either enforce the indication of the category for a URL or suggest alternative categories for the URL.

5. Experimentation

A prototype tool for categorisation by context has been built in order to verify the validity of the method.

An HTML structure analyser has been built in Perl, derived from the analyser used in Harvest. A spidering program has been written in Java™, which uses the HTML analyser to produce a temporary file of URL Context Paths. Also in Java™, we developed a categoriser program that interfaces to WordNet [Miller 95] to perform morphing of the words appearing in the context paths and other linguistic analysis.

We have used the Arianna [Arianna] catalogue for the experiment, translating into English their names, and we categorised a portion of Yahoo™ [Yahoo].

We show part of the results of categorisation for the URL http://esg-www.mit.edu8001/esgbio, appearing in page http://www.yahoo.com/Science/Biology For each candidate paths on the left we show the corresponding match weight vector, which has an entry for each element of the path representing the weight of the match for the corresponding title.

```
science ..................................... 3.24
science : general ........................... 3.24      0.0
science : earth ............................. 3.24      0.0
science : psychology ........................ 3.24      0.0
science : mathematics ....................... 3.24      0.0
science : engineering ....................... 3.24      0.0
science : physics ........................... 3.24      0.0
science : computer .......................... 3.24      0.0
science : biology ........................... 3.24      2.06
science : botany ............................ 3.24      0.0
technology : biology ........................ 0.0       2.06
```

The grading of candidates for http://esg-www.mit.edu8001/esgbio produces the following:

```
science ..................................... 1.0
science : general ........................... 0.5
science : earth ............................. 0.5
science : psychology ........................ 0.5
science : mathematics ....................... 0.5
science : engineering ....................... 0.5
science : physics ........................... 0.5
science : computer .......................... 0.5
science : biology ........................... 1.565465
science : botany ............................ 0.5
technology : biology ........................ 1.065465
```

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Despite the limitation of the current prototype, the results are quite encouraging. In all the cases we examined the prototype was able to categorise each URL in the most appropriate category.

As an experiment to determine the quality of the categorisation, we asked the system to categorise a subset of the Yahoo! pages according to the same Yahoo! catalogue. In principle we should have obtained exactly the original categorisation, and this is what we obtained in most cases. In a few cases the algorithm produced an even better categorisation, by placing a document in a more specific subcategory: for instance

6. Conclusions

We described an approach to the automatic categorisation of documents, which exploits contextual information extracted from the HTML structure of Web documents. The preliminary results of our experiments with a prototype categorisation tool are quite encouraging. We expect that incorporating further linguistic knowledge in the tool and exploiting information from a large number of sources, we can achieve effective and accurate automatic categorisation of Web documents.

We plan to apply our technique to the Arianna service in various ways: (1) using automatic categorisation to extend the Arianna catalogue, (2) adding to the Arianna search a facility to group the results of queries by categories, (3) a facility to restrict a search within a category.

A further area of research is evolving categorisation, i.e. to discover cases when the categories in the catalogue need to be extended or revised. Such analysis could be based on the Context Paths for documents.

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Student WWW Pages: An Investigation into How Students Learn to Create Web Pages

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Abstract: The development of a new pedagogical model predicates the use of new assumptions in teaching at the university level. The first assumption is that the traditional design and behavior of university classrooms might not be appropriate for the instruction of computer-based curriculum. The second assumption is that students will change their learning approach to solve the problem of creating a project in a new medium. During this presentation, the researcher will summarize the result of this investigation into how students learn to design web pages. In addition, there will be a demonstration of the intermediate and final web pages. Through the interaction of the audience and the researcher, it is hoped that further discoveries about the learning of students will be uncovered.

Introduction

In the past two years, there have been many articles about specific uses of the WWW in education but few have investigated the Web as a learning medium. Antchev et al. [96] described the components and implementation of a WWW-based learning environment for mathematical sciences. These researchers used HTML documents, hypertext links, animations, and video clips to display and expand on mathematical ideas. They enhanced the Web content by using EMAIL, bulletin boards and videoconferencing software. In another course developed for the Internet, researchers found that WWW-based instruction acted like a catalyst for student achievement--it changed the "student role from passive learner to a partner in the goal of constructing meaning and understanding through interaction" [Campos, Salcedo, & Rossel 96, p. 60].

Universities across the country and world are pursuing full-course implementation on the Web [see McGreal 96; Paquette et al. 96]. Models for WWW-based instruction exist in the literature [Team Web 95; Rebelsky 96]; however, few studies exist that look at developing a pedagogical model for instructing students to construct their own web pages. One study on this topic [Bos et al 97] focused on students' use of web authoring to improve their cognition and motivation in science. The authors believed that web creation was an effective method for the science curriculum because it supports the sociocultural aim of science in that "learning to communicate with other scientists is an important part of learning to do science" (Abstract). Reed [96] points out that computer-mediated writing classes tend to be democratic and inclusionary--one could extend this principle to web creation by students.

Fryatt [95] focused on the complex issues of Internet training and implementation in her comprehension review of training. Particularly, her review targeted three questions:

1. What are the factors that distinguish successful Internet implementation and training strategies from those are not successful?
2. What models or approaches might be effective in reaching educators?
3. What systems/resources are necessary to support and extend the training process?

Fryatt discovered through her review that the actual training of instructors in just the beginning of the implementation plan. "What is often implied by such efforts is altering a mindset or philosophy about teaching and learning that requires teachers to acquire a whole host of related skills -- which are not usually even recognized within the training process."

Methodology

This investigation builds upon previous work on the nature of student use of computers for instruction [Backer 97]. Backer had analyzed student learning in constructing an electronic portfolio using computer-based multimedia development tools. The development of portfolios by students was not a cursory process. In order to be effective, portfolios require students to become self-reflective and view their work as a whole rather than as unrelated pieces. Electronic resumes, as natural technological outgrowths of portfolios, can expand this active process further by encouraging students to express themselves visually as well as in written form. In addition, this study shows that the use of electronic portfolios brings learning that is interactive and socially based.

The question then evolved for this current investigation. Since students approach the design of multimedia in diverse ways and with varying results, how do they approach and learn how to create web pages? This question forms the basis of this qualitative study. Twenty students, taking an undergraduate multimedia and web design course, were tracked over the course of the semester. Samples of web pages were taken from the students at three intermediate points throughout the semester. In addition, their final web page was evaluated. The web pages that the students constructed were analyzed as to various HTML design attributes to attempt to determine how the students' web designs evolved over a semester.

A qualitative approach was taken with these web creation activities to better analyze them for style as well as content. All students in this class were divided into teams and given the same assignment for developing the web pages. The majority of this presentation will be on the analysis of the students' intermediate web pages and a comparison of these intermediate points with other students in the class. The focus in this study, however, is on attempting to determine how students learn to use new tools rather than on the final projects. In this way, this present project differs from others completed. Most research on students (and/or faculty) is directed towards the analysis of their final projects. Inside of highlighting the final outcome, the emphasis on intermediate steps should provide more information about the learning processes of students. Consequently, it is hoped that this research will give insight in to the development of new pedagogical methods for instructing in multimedia.

Kerr [91] stated that "those of us who try to foster the use of technology in the schools are often guilty of hubris: We start from a premise that the value of the new approach we urge is self-evident, and that teachers should naturally want to shift their ways radically to take advantage of the new." Although Kerr was writing about teachers, this point also rings true about students. Despite the use of new technologies in both teaching and learning, we forget that education is also a social process with hundreds of years of explicit and implicit rules of behavior. Previous research [Backer 97] has found that students freely collaborated with each other, both in designing the multimedia as well as critiquing the content of their work. Therefore, a concerted effort was made in this investigation to encourage such collaborations by using teams of students to design web pages.

Results

The development of a new pedagogical model predicates the use of new assumptions in teaching at the university level. The first assumption is that the traditional design and behavior of university classrooms might not be appropriate for the instruction of computer-based curriculum. The second assumption is that students will change their learning approach to solve the problem of creating a project in a new medium.

During this presentation, the researcher will summarize the result of this investigation. In addition, there will be a demonstration of the intermediate and final web pages. Through the interaction of the audience and the researcher, it is hoped that further discoveries about the learning of students will be uncovered.

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Using an Automatic Retrieval System in the Web to Assist Co-operative Learning

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Abstract:

We present an information agent and latent semantic based indexing architecture to retrieve documents on the internet. This system optimises the search for documents in the internet by automatically retrieving relevant links. The information used for the search can be obtained, for instance, from Internet browser caches and from grades of relevance manually informed. To leverage the scope of retrieved documents, the system makes use of existing indexing mechanisms. Returned documents are then filtered using Latent Semantic Indexing (LSI). In a co-operative environment, the proposed architecture provides for sharing of documents and grades among the group. The architecture has been used in a "Co-operative Learning Environment" where students share their browser caches and retrieved documents

1 Introduction

The huge amount of information available in the Internet allows research on virtually any subject. However, this wealth of data makes it almost impossible to retrieve relevant documents for, say, a school project. Therefore, we need automatic methods to retrieve information in an easy and significant way. If we can make the process transparent its usefulness would be even bigger.

Some of the common solutions available today include search using indexing servers. The problem with this approach is that the user must explicitly select keywords, activate the search mechanism, wait for the response and identify the relevant documents returned. All steps require user input. We propose an architecture that makes use of existing indexing mechanisms but automatically filters the relevant URLs, presenting only the relevant ones. In our system, although the user may manually give some information, the whole process can be automatic.

2 The architecture

The proposed architecture automatically retrieves relevant documents over the internet. It makes use of context information as input to perform the search and to filter the returned URLs. The mechanism is called *Metasearcher*.

The document retrieval mechanism is implemented using an information agent. The architecture is made up of three modules: context reconnaissance module, search module and filter module, as we describe in the following sections.

3 Information agents

Information agents are programs that model an information space of a user. They are not well defined. An agent are characterised for operating at high levels of abstraction and usually for the use of distributed resources. Like specialist systems, "information systems are hard to be characterised but easy to be identified" [Cybenko et. al 1990]. However, unlike a specialist system that models one specialist (one person) and makes his knowledge available to many users, an agent models one user, his needs of information and actions. Therefore, an agent must be customised for each user, making programmability a basic requirement for it. A definition of an information agent can be found in [Cybenko et. al 1990].

3.1 The architecture of the information agent

The proposed information agent models a human assistant that creates links using a behaviour similar to a human being [ACM, 1997]. A human assistant would read the information searched by an user and would extract the context from this information. In the next step, he would define keywords to search the internet using existing indexing mechanisms (e.g. Altavista). Finally, he would "read" the returned documents and select those that are really relevant in the context identified. Finally, he would build an HTML page to be presented.

To perform its role, the agent executes three basic tasks: first it reads the context information and identify keywords; second it submits searches to indexing mechanisms and finally it filters the information returned using the context obtained in the first task as model. The process is shown in Figure 1 where:

- The context reconnaissance module identifies the context and creates keywords to be presented to the search module. The scheme used to generate the keywords is shown in Figure 2. This module also creates a semantic space (using LSI [6]) from the context information.
- The semantic space will be used in the filter module to verify relevance of returned documents. Context information can be obtained from Internet browser caches, users' bookmarks, a set of documents regarded as interesting, etc.
- The search module submits (in parallel) the actual search to indexing mechanisms, receive the responses and assembles an HTML page to be submitted to the filter module.
- Finally, the filter module retrieves the full documents whose URLs were returned in the search module. It then retrieves (in parallel) the full documents and adds them to the semantic space computed in the first module. Documents that position themselves near the existing documents are regard relevant and presented to the final user. Documents that do not stay near the existing ones are discarded. The filtering module is the kernel of the proposed architecture is explained in detail below.

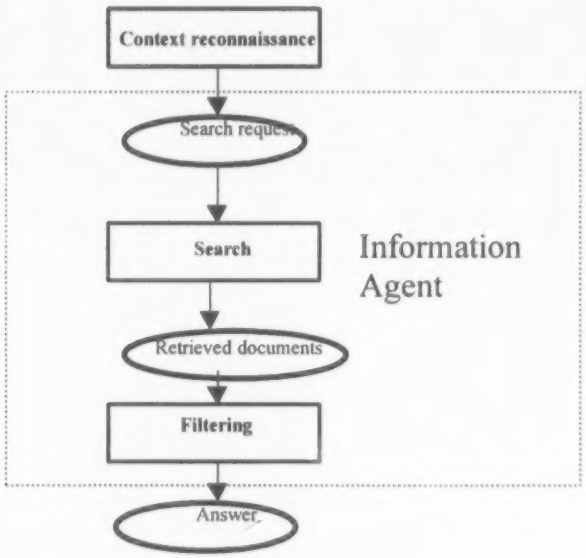

Figure 1: The Architecture of the Agent

3.2 The filter module

The search using keywords has many drawbacks. The search may fail because of synonyms and polysemia (more that one meaning to the same word). To reduce these problems several filtering techniques can be used [Foltz & Dumais, 1992]. We have decided to use LSI [Dumais, 1991] [Dumais et al. 1988] to filter the documents retrieved.

LSI takes advantage of the higher implicit order of the association of terms to documents in order to create a multi-dimensional semantic structure of the information. Using the patterns of co-occurrence of words, LSI is able to infer the structure of relationship between terms and documents. The singular Value Decomposition of the association term-document matrix is obtained producing a matrix, with reduced dimensions, with the k best orthogonal factors to approximate the original matrix to the "semantic space" model for the collection. This semantic space reflects the main associative patterns in the data ignoring some minor variations that may be produced by idiosyncrasies in the use of the term in particular documents. Therefore, LSI produces a representation of the adjacent information "latent" semantics.

Because LSI produces an adjacent similarity semantics space, documents on similar topics tend to be grouped in the space. That is the base of the use of LSI. We first create a space based on information known to be (or regarded as) relevant and then new documents are added to the space. If they position themselves near the existing ones, they are regarded as relevant, otherwise they are discarded.

To implement LSI, a term-document matrix is built. The elements in the matrix are the occurrences of each term in a document. Therefore, the matrix can be represented by $A = [a_{ij}]$ where a_{ij} denotes the frequency that term i occurs in document j. Global and local weights can be applied [Dumais et al. 1988] to increase or decrease the importance of terms within between documents. We can then write $a_{ij} = L(i,j) \times G(i)$ where L(i,j) is the local weight of term i in document j, and G(i) is the global weight of term i. Matrix A is factored in a product of three matrixes using the Singular Matrix Decomposition (SVD): $A = U \Sigma V^T$.

SVD derives the model of the latent semantic structure from the orthogonal matrixes U and V with the left and right singular vectors of A respectively, and the diagonal matrix Σ, of the singular values of the original relationships into linear independent vectors. The use of K factors is equivalent to approximate the original term-document matrix by A_k as defined in equation

$$A_K = \sum_{i=1}^{K} u_i \cdot \sigma_i \cdot v_i^T \text{ , where}$$

A_K = best approximation of rank k to matrix A	m = number of terms
U = term vectors	n = number of documents
Σ = singular values	k = number of factors
V = document vectors	r = Rank of A

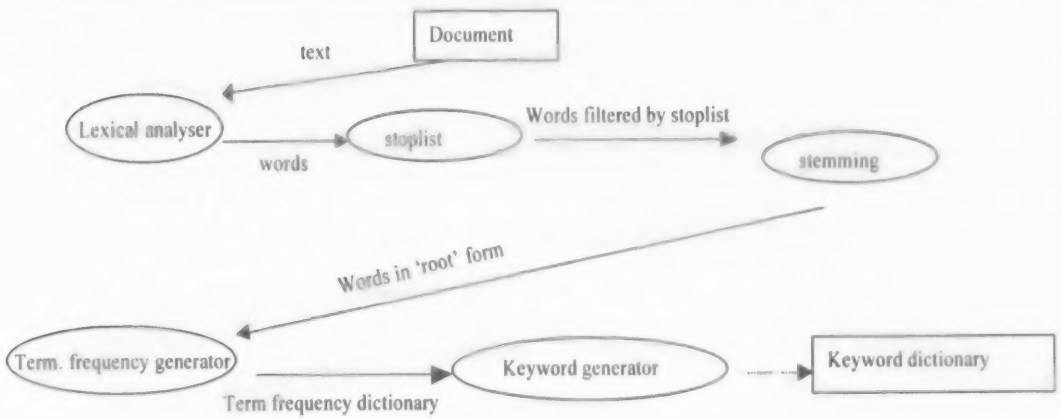

Figure 2: Keywords generation process

Figure 3 is a mathematical representation of the decomposition into singular value. U and V are the term and document vectors, and Σ represents the singular values. The shaded regions in U and V the diagonal line in Σ represents A_k.

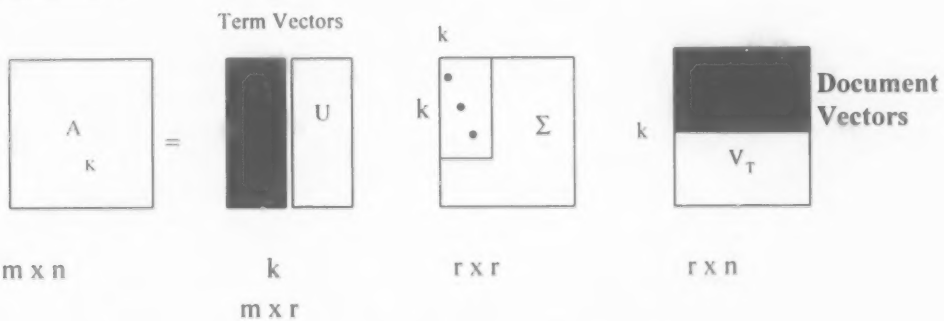

Figure 3: Decomposition into singular value

SVD captures most of the adjacent structure in the association terms-documents and, at the same time, it removes the variability in the use of words. Intuitively, as the number of dimensions k is much smaller than the number of unique terms m, minor differences in the terminology will be ignored. Terms that occur in similar documents, for example, are close even if they do not occur in the same document. That means that documents that do not share any words with the keywords in the search may be close to a keyword in the k-space. This representation captures term to term associations and it is used to retrieve information. The main idea in LSI is to model the inter-relationships among terms and use them to improve retrieval.

As we have explained, *Metasearcher* retrieves documents obtained from the indexing mechanisms. To be filtered, these documents are used in a "query" to obtain their similarity to relevant documents in the vetorial

space. One query is a set of words. The retrieved document, or query, must be represented in the k-dimension space as $q\hat{} = q^T U_k \Sigma_k^{-1}$, where q is the vector of words in the new document, that can be multiplied by the appropriate term weights. The sum of these k-dimension vectors is reflected by term $q^T U_k$ and the right multiplication by Σ_k^{-1} weights differentially individual dimensions. Thus, the query vector is located in the weighed sum of its constituents term vectors. The query vector can then be compared to all existing document vectors, using a similarity function. One similarity function is the cosine between the query vector and the closest vector in the vectorial space of relevant documents. Usually, if the cosine exceeds a threshold the retrieved document is regarded as relevant [Dumais, 1991].

Documents not regarded as relevant are discarded and relevant ones are presented to the output system as an HTML document.

4 Scenarios of usage

Metasearcher can be used together with several systems. It is implemented as a modular architecture that allows the input and output modules to be changed to adapt to different requirements.

For example, the input system can collect data from one user and use that information to retrieve other document on the same subject, or the input can come from an intranet supporting a co-operative environment as it has been tested in [Badue et. al, 1998]. In this case context information (including information manually entered), and returned documents are shared by a group. Another scenario would be the one where a student who needs to write an essay to "train" *Metasearcher* with a set of papers on the subject and have it to retrieve other related documents.

5 Performance

The system is still being tested. It has been used by a group of five students who are given a task and should search the Internet (starting with an empty cache) until they build a cache of about 1.5MB of html documents for each user. After the cache is loaded, the system is left to work, usually overnight because of slow connections.

Although the number of documents retrieved by indexing engines vary a lot, typically 60% of them are filtered by the engine. We have found that the input system, specially the interface, has to be improved to allow users to manually discard non relevant documents. In tests where non relevant documents were discarded from cache manually, the rate of filtered documents raised to near 80%.

Although the results are very promising we still need more tests to assess the system. We have found that the input system has to be improved to allow users to input feedback with less effort, and to share their "filtering" with other users. Users have had the "feeling" that the system retrieves more relevant information when caches are shared than when they use their caches only. However, we have not yet assessed how correct that "feeling" is.

6 Acknowledgements

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7 Conclusion

This work has proposed an architecture based on information agents to automatically retrieve documents in the Internet and filter the returned documents, using LSI, according to context information. The proposed architecture makes use of indexing mechanisms and is modular, in the sense that its input and output modules can be changed.

To perform its role, the system obtains context information from a source that can be Internet browser caches, a directory of papers, etc. Then it uses that information to generate keywords that are submitted to existing indexing mechanisms, the returned URLs are retrieved an the full documents are matched to the context using LSI. Finally, it generates an HTML page that is passed on to the output system that may perform further computation or just present the page to the final user.

Metasearcher has been "plugged" to an intranet environment in an University environment, where it is used to support co-operative learning. Currently, the system is being tested and data is being gathered to asses its effectiveness as a learning aid.

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THE STATE OF THE 'NET IN IN SECONDARY CLASSROOMS: RHETORIC AND REALITY

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Abstract: While 96% of teachers profess to use technology, our study of 85 teachers in Florida and Georgia found that only 4% of teachers actually integrated technology in their instruction. The majority of schools had few computers, fewer Internet-ready computers available for student access, and teachers who had never received any training whatsoever concerning how to use computers. Most teachers lacked even a rudimentary knowledge of the Internet; many could not explain how to turn on a computer. The reality of public school classrooms contrast sharply with the rhetoric and possibilities of using technology effectively in schools as exemplified by some interesting, high-tech classrooms.

"While those who talk *about* schooling describe its penchant for change, teachers who *do* schooling proceed about their business in a manner that is remarkably resistant to change....the introduction of technology to classrooms does not radically change teaching; instead, technology can serve as a symbol of change." [Sandholtz, Ringstaff, & Dwyer, p. 171]

The point is well taken that most classrooms today look and sound as they did a hundred years ago—blackboards, functional seating with built-in desks and storage for books underneath, a pencil sharpener, an American flag, a teacher speaking at the front of the room. In contrast, the tools and the core knowledge of today's doctors, lawyers, accountants, dentists, engineers, police officers, and farmers would be unrecognizable to professionals from one hundred years ago. In many respects, the computer is perceived as a possible remedy for the flagrant datedness of most classrooms, and several federal and state initiatives continue to help bring computers into schools. Yet, getting prospective teachers to abandon pedagogical habits far removed from their comfort zones is no easy task. In fact, the complexities of integrating technology into the classroom seem to continually increase for teacher educators. But, the difficulty of the enterprise does not negate the potential that computers may offer. Many teacher education programs find themselves in the precarious position of mandating that their students gain expertise with computers while the school districts that may hire them may have classrooms straight out of 1898.

At the same time that the massive effort to equip schools with a necessary infrastructure for technology, some have begun to question the benefits of such investments, leading to speculations on the effects of technologies on teaching and learning [Dickey & Robyler, 1997; Dede, 1997; Oppenheimer, 1997]. Even technology enthusiasts would agree that simply unloading boxes of computers into K-12 classrooms will not improve instruction much. There is a need for practical examples of expert computer use in K-12 classrooms, a set of "best practices" that demonstrate how computers can be integrated into instruction to offer a clearly richer curriculum. In this article, we will discuss research from a three-year study of "best practices," describe the level of computer use in these classrooms, relate the findings to the preparation of prospective teachers, and briefly describe a day in the life of a teacher from the research study who might serve as a model of "best practices."

According to Fisher, Dwyer & Yocum [1996], criteria for best practices for the computer-literate teacher should include the following:

- Availability of tools for acquiring information, thinking, and communicating,
- Teacher's balanced used of instructional strategies--direct instruction, collaborative, and inquiry approaches to teaching and learning, and
- Ability to formulate innovative and variable assessments of student competencies and skills.

In order to study the best practices of current teachers, we asked principals and administrators for a list of their most effective teachers who wouldn't mind being observed or videotaped. We logged over 500 hours in classrooms watching and videotaping 84 teachers [in grades 5-12] from Florida and Georgia over a period of three years. Administrators and teachers were told that the researchers were interested in "effective practices" and nothing about computers was ever mentioned.

The classrooms in Georgia and Florida are considered among the most sophisticated in the nation regarding the integration of technology. According to a report in *Education Week* [November 11, 1997], "Florida is one of the nation's leaders in school technology, and financial resources are a major reason why" [available: http://www.edweek.com/sreports/tc/intros/in-n.htm]. The student to computer ratio in Florida is purported to be 6:1.

Since 1994, the lottery in Georgia has provided more than half a billion dollars for technology in schools and the legislature also approved $15.4 million to pay for district technology specialists. The ratio of students to multi-media, Internet-ready computers is among the best in the nation in that category--13:1.

Computers in instruction: A disparity between reported and actual use

Teachers were observed from these subject areas--English, reading, math, science, social studies, family & consumer sciences, foreign language, and art, grades 5-12. All teachers observed had at least three years of experience, and a few had as many as 25. In general, the classrooms observed were not well equipped with computers, almost all teachers confessed that they had never received any form of professional development from their school districts regarding the integration of computers into instruction, and computers were not integrated into instruction. While we witnessed many innovative, unique, and highly effective lessons, the use of computers was conspicuously absent in 81 of 84 classrooms. Table 1 summarizes some major findings of the study.

Table 1: The integration of computers in instruction

	Florida	Georgia	Total
teachers observed	50	34	84
number of teachers whose classrooms contained no computers that could be accessed by students	48	30	78
number of teachers who have received professional development in the integration of computers in their teaching	0	2	2
number of teachers with one or more computer available for student use	2	4	6
number of teachers who used computers as part of their instructional strategies	0	3	3

Obviously, our findings of actual classroom practice differ markedly from reports attesting to the proliferation of computer use in schools. When surveyed, almost every teacher in the country says that they use computers to some degree in their teaching. According to Quality Education Data, 96% of teachers integrate computers in their instruction [1996]. The Tenth Planet Teachers & Technology survey found that 91% of K-6 teachers use computers with their students [1997]. The disparity between the results of these surveys and the actual approaches teachers took during our observations provided a rather startling contrast. Perhaps one problem with surveys of computer use is that they rely upon data that is self-reported. In the current age, when use of

technology has become associated with competency and modernity, little wonder that few teachers would admit that they never boot up. Still, the difference between actual observation of computer use in teaching—3.6% [3 of 84 teachers] and the purported use—96%—seems nothing short of stunning.

The dilemma of "best practices"and teacher preparation

According to Sternberg [1995], expert teachers are those who "possess knowledge that is more thoroughly integrated — in the form of scripts, propositional structures, and schemata--than is the knowledge of novice teachers" [p. 11]. One of the difficulties of integrating computers effectively into the curriculum may be that teachers have not yet begun to integrate the use of computers into their teacher "scripts." Indeed, of the three teachers who used computers, only one [George, to be discussed later] seemed to have integrated computers seamlessly as part of his pedagogical toolkit.

A second teacher [of sixth graders] arranged her class so that all twenty-seven students sat in a circle on the floor around a computer monitor "interacting" with a science CD-ROM. She selected one student at a time to walk up to the terminal and point and click on an object on the screen while the other twenty-six children sat, watched, and listened-- a technique that we found to be of questionable educational value. A third teacher who integrated computers as instructional tools used the four Internet computers in her classroom as stations where students could pursue their individual research projects once or twice a week. When we observed the class, the students assembled around the computers were seeking information concerning the life and times of William Shakespeare. While there may be nothing inherently superior about learning that is facilitated through the use of computers, our research helps point out the entrenched, almost covert resistance to computers as instructional tools.

The dilemma faced by many teacher education programs is that they must prepare prospective teachers who are informed users of technology at a point in time when few practicing teachers seem to be exhibiting the kinds of expert behaviors that would qualify them as practitioners of computer-mediated "best practices." Indeed, if prospective teachers are going to be expected to move beyond the methodology of the teachers who taught them, the need for living, breathing teachers who use computers creatively and effectively is essential. Below, we offer some observations of a day in the life of George, a fifth-grade teacher and the "star" of the cohort of 84 teachers. George seemed to use computers effectively, though his classroom was not particularly well equipped and he learned about computers without the assistance of any college coursework or help from the district administration.

George, an exemplar of "best practice"

At 9:00 on a Tuesday morning, George is describing the listed day's events, written on the chalkboard to some fifth graders seated in a semi-circle, on the floor. After the description, the students disperse to their desks as they are instructed to begin with the Language Arts unit. Some students pull-out their journals, others turn to the hand-out from the student teacher, and three girls in one corner take out novels from their book bags. George announces that he expects the students to continue the special research projects. He bids Jon to move to the scanning station [a Pentium 75 hooked to a scanner and a color inkjet printer] with his baby picture. Jon is shown how to scan his picture using a generic scanning software. After he scans, the image is cropped and pasted on a card in Microsoft Publisher. Jon selects the appropriate "Happy Birthday" text and wording for the card. George helps him print and fold the card. Two other students rush to see Jon's finished product which he completes in about seven minutes.

George next beckons Stacy to join Jon at the scanning station, bringing along a recent picture of herself. Jon moves to the chair next to her to assist her in creating her Xmas card. Jon's words and actions indicate a slight hesitancy as he and Stacy explore the steps from scanning to card creation. But, as Stacy darts to the printer to retrieve the card, the look on both faces changes to quiet confidence. It is now Stacy's turn to assist Mike in creating his Thanksgiving card.

At George's laptop [the only computer with Internet access], Josh is searching for pictures to include in his research project on minerals. He suddenly remembers that he forgot his picture for the greeting card project, so he decides to page his dad on the Internet. He logs on to "www.metrocall.com" and leaves a message on his dad's toll-free pager number, to "drop-off the baby picture at school." He then logs on to www.altavista.com [a search

engine on the Internet] for pictures on minerals. He first searches the keyword "quartz" and sorts through some hits on wrist-watches. He then searches for "minerals" and gets several more hits, one of which is simply titled, "Rhombohedron." He clicks on that site and discovers 20 or more colorful digital pictures of six-sided prisms. He bookmarks the site and prints some pictures. The printed pictures are added to his resource folder which also contains magazine clippings, photocopies from books, and a crumpled set of handwritten notes.

Until the fall of 1996, the only computers at George's school were Apple IIe's. In the Fall of 1996, George and a concerned parent networked the donated Mac Classic IIC's to the only laser printer in the school. For years, the only computer with Internet access in school has been George's laptop [though the school is scheduled to be wired as this is being written], and he paid for the America On-line [AOL] account from personal funds.

His class now has 4 computers: a Pentium 75, a Compaq laptop [Pentium 150], a Mac Performa 616CD, and a Mac LC. In addition to some input and output peripherals such as a scanner, a digital camera, and printers, he also has a television and VCR set. Although George teaches 5th grade, some 4th and 6th graders participate in the language arts and math learning activities upon occasion. Although George would not mind if his school had a computer lab, he prefers having computers in his classroom as part of the learning environment. George encourages students to pursue divergent thinking by using whatever other resources they can get their hands on. During the first semester of fifth grade, George introduces students to:

- Classroom resources [digital camera, computers--CD-ROM, scanners, Internet sources and databases, textbook, and publications],
- School-based resources [library, VCR, camcorder, and photocopier]
- Community resources [parents, good hiking trails, and libraries].

George balances direct instruction with collaborative and inquiry approaches. When George brings in new technology, he will demonstrates use of a tool to the entire class, then walk several students through the entire process individually. Next, the students who received individual instruction, in turn, assist a classmate. When a student gets confused or needs help, George will refer them to resources in the room rather than give straight answers. "I expect students to develop critical and higher order thinking and they won't get that by my class if I spout off the answers all the time. Frustrations arising from using new technologies and doing research are part of life. Students need to learn such life lessons."

He admits that his teaching practice during the first semester is largely direct instruction, but maintains that 5th graders need to be taught the inquiry process as well as see it modeled before they are required to collaborate and/or independently explore with multimedia tools.

His second semester activities often involve data gathering for science and math projects to writing, editing, and publishing in language arts. Some of the publications are on-line, but one project revolves around the production of an annual section in the local newspaper.

George's assessment methods include student self-evaluations and documentation of the processes students use to create their projects. He insists students keep portfolios that fulfill a few rigorous requirements, though he allows students to customize their portfolios to some extent to reflect their personal interests. George regularly schedules conferences with students to discuss portfolios.

The desperate need for models of best practice

There is a private university in the Southeast that graduates 1000 undergraduates and 500 graduate teacher education students every year. The College of Education at this institution is housed in a 100,000 square foot building that includes 113 miles of fiber-optic cable, 1100 plug-in ports hooked to the Internet, and at least one multimedia laboratory in every room. The teacher's station has a pop-up LCD panel, which can electronically control a screen that drops down out the ceiling, mechanized drapes which can be opened and closed at the touch of a button, and a built-in projector in the ceiling for illuminating computer screens, videos, or cable television programs. Access to the building and to each room within the building is controlled by card-readers which restrict access to only those who possess the correct chip. One floor of the building is dedicated to graduate students, who eagerly plod away in corporate-type offices on projects for professors who may want to design supplemental course materials on CD-ROM.

A few blocks away from this university is an inner city public school, in which there are few classrooms with computers for teachers, let alone students. Windows are broken, doors are chained shut, there is no Internet access, and no teacher has an office of her own. Imagine the soul-searching that a prospective teacher who gets trained in the private university teeming with high-tech toys undergoes the first day that she steps foot in the battened-down urban school down the street. To what extent can she draw on her university courses to enhance instruction in such a foreign and technologically barren environment?

From our research of computer use among practicing teachers, it would difficult to foresee that the prospective teacher in this situation would find a willing, technologically-innovative mentor among the school faculty who could ease her transition into teaching, while simultaneously encouraging her to take chances in her choice of instructional methodologies. To be sure, without models of best practice, like George around, someone to demonstrate the plausibility of technological approaches, most pre-service teachers would likely adopt survival strategies that minimize complexity and eschew the kinds of complications that computers inevitably bring.

Perhaps the time is right for the establishment of a National Technology Project, a nationwide program built along the lines of the highly-successful National Writing Project, a professional development effort that has trained over 100,000 teachers over the past quarter of a century to become better teachers of writing. By using a teachers-teaching-teachers model such as that of the National Writing Project [Gray & Sterling, 1995], a National Technology Project could provide the ongoing professional development necessary to bridge the gap between the reality of public schools struggling to get up to speed and vast potential offered by emerging technologies. Teachers are key to educational reform. Although teachers like George seem to be quite rare, it is they who must help lead the transformation.

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Disorientation on the Web—Adventure or Distraction?

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Abstract

This experimental study investigated both internal (personal characteristics) and external (web site features) factors influencing disorientation in web navigation. The research design is a 2X2 ANOVA with mode of navigation (linear, nonlinear) and distractions (high-distraction, no-distraction) as the two factors. The paper reports findings of the following dependent measures as they relate to the 2-factor research design: friendliness of the web site, attribution of disorientation, overall level of disorientation, accuracy at stating main point of the passage, number of ideas recalled from content of passage, confidence in navigating the web site passage, and interest in web site passage topic. One primary hypothesis that was not supported was that preference for sensation-seeking behavior and/or spatial-holistic ability would influence the participants' perceptions of disorientation.

1.0 Introduction

A common phenomenon on the World Wide Web is for a participant to become sidetracked by other links and become disoriented when seeking a particular location. From the participant's perspective, did s/he make the right choice or will s/he have to back-track? Did she temporarily ignore her original intent because she has a high need for novelty and stimulation? Additionally, much of the inconvenience of disorientation may be perceptual. Like waiting in line at the grocery store, where some people become livid while others use it as a chance to start up a conversation, disorientation on the web may be considered as exciting or as an annoying distraction that prevents the participant from staying on-task.

Given the rapid growth of the Internet and the commensurate need to design improved systems for participant access and learning, this study investigates psychological issues related to navigation in the World Wide Web. Specifically, the focus is on internal and external factors related to disorientation, defined as uncertainty in one's location.

Results have important implications for Internet participants and directly impact web-based system configuration and participant interface development. By assessing *perceived factors* relating to web navigation, the research provides information regarding the web site features that participants believe are important for a site's participant-friendliness. Furthermore, this research will consider the factors influencing whether the participant attributes his/her disorientation internally (to him/herself) or externally (to the web site).

2.0 Purpose

The purpose of this experimental study is to characterize internal (personal characteristics) and external (web site features) factors that influence Internet navigation and disorientation. This research also facilitates the development of web-site features that better accommodate navigation preferences and learning. For example, a person low in sensation-seeking tendency may prefer a more streamlined approach to navigation with limited links whereas a person high in sensation-seeking tendency may prefer more varied navigational features with a greater number of available links or distractions. In terms of learning, the participants will be tested for content learned from the participant's navigation of the web site passage. This has direct implications for design and development of web-based learning environments.

3.0 Participants

Volunteer participants were recruited from Internet listings that advertised the study, drawing from a diverse nationwide population. All participants had prior experience navigating the Web as a requirement of participation in the study. They were compensated for participation.

The seventy-five participants represented a diverse population, with 79% white and 21% non-white (including primarily Asian and Hispanic). The mean age was 30.47 with a standard deviation of 1.26. Of the 74 participants reporting gender, 34 (46%) were female and 40 (54%) were male.

4.0 Experimental Design

The study was designed as a two-way ANCOVA design with system knowledge as the covariate because systems knowledge has been shown to directly affect participants' competencies at navigation (Hill & Hannafin, 1996). However, systems knowledge scores were very high (X=4.08 on five point scale) and positively skewed, precluding the value of using them as a covariate.

Consequently, the experimental design is comprised of a 2-factor (2x2) ANOVA design with the two factors of navigation mode (linear, nonlinear) and distractions (high-distraction, no-distraction). There are four web sites that reflect different instantiations of the two factors (e.g., linear + high-distraction; linear + no-distraction; nonlinear + high-distraction; nonlinear + no-distraction). The four web sites all contain nine web pages of identical text that comprise a passage on *Internet use for education*, adapted from Andy Carvin's web site at http://edweb.gsn.org/web.intro.html. The software randomly selected one of four web sites for each participant to navigate.

In the linear navigation condition, the participant is forced to proceed through the site similar to reading a textbook, only able to move forward and backwards. While this is a somewhat artificial treatment, it was designed to maximally contrast with the nonlinear mode of navigation. In the nonlinear navigation mode, the participant has immediate access to all pages at any given time through a navigation bar on the left-hand column.

The high-distraction condition contained six distracting links placed throughout the nine pages of the web site. The six distracting links (referred to as "distractors") were designed to figuratively "seduce" the navigator to click on the link (e.g., David Letterman's Top Ten, jokes, Dilbert cartoons) and encourage off-task behavior. Each distractor was comprised of a small picture with a link indicating to "Click here to ..." The no-distraction condition did not contain any distractors.

4.1 The Task

The task for all participants was to successfully find the headings under which five statements were located within the nine-page online passage. Participants could access the statements from any page on the web site.

In determining the appropriate heading location, the participant did not have open-ended access to the Internet; rather, s/he was limited to the pre-defined web pages for each web configuration. The toolbars were de-activated so that s/he could only access web pages included in the experimental web site. Software was developed in Perl to track the participant's path through the web site in terms of total time spent, time spent on distracting links, and the number of distracting links selected. The whole procedure took approximately an hour.

5.0 Research Procedures

Following completion of the initial task, the participant was profiled online according to the following two psychological dimensions: preference for sensation-seeking behavior and visual-spatial ability. Also in terms of personal characteristics, participants were queried about prior content knowledge of the passage and systems knowledge. Additionally, the following dependent measures were assessed through an online questionnaire:

1. Friendliness of the system
2. Attribution of disorientation
3. Overall disorientation
4. Accuracy at stating main point of the passage
5. Number of ideas recalled from content of passage
6. Confidence in navigating the site
7. Interest in passage topic

6.0 Key Predictions

1. Individuals differing in sensation-seeking preference and visual-spatial ability will prefer different web-site features. For example, a person low in sensation-seeking tendency may prefer a streamlined site with limited links and options whereas a person with high sensation-seeking tendency may prefer more varied navigational features with more links and/or distractions. Furthermore, it was predicted that these two factors would influence perceived disorientation and frustration with navigation on the web site.

2. Different web configurations (as defined by level of distractions and navigation mode) would differently affect performance on learning and affective measures (as listed 1-7 above).

7.0 Results

7.1 Participants' characteristics

The following information was collected about the participants: preference for sensation-seeking behavior, spatial-holistic ability, content knowledge of the passage's topic, and systems knowledge.

7.1.1 Sensation-seeking preference

Participants answered a battery of questions pertaining to preference for sensation-seeking tasks (from Zuckerman, 1979). These 34 questions consisted of paired statements from which the participant would select the one statement best describing him/her. For example: A) I would prefer living in an ideal society where everyone is safe, secure, and happy; or, B) I would have preferred living in the unsettled days of our history. The mean score of the participants was 18.50 (*sd*=5.83) with a possible range of 0-34.

7.1.2 Spatial-holistic ability

The Street Test (Street, 1931), a thirteen-item gestalt completion test, assessed spatial-synthetic ability and required the participant to mentally construct the whole picture from a partially-represented figure, such as a figure of a bearded man, a cat, or a locomotive. The mean score of the participants was 7.36 (*sd*=2.52) with a possible range of 0-13.

7.1.3 Content knowledge

Participants' mean prior content knowledge of the use of the Internet for education was 3.65 (on a 1-5 Likert scale where 5 is extremely knowledgeable) with a standard deviation of 1.05.

7.1.4 Systems knowledge

As mentioned previously, systems knowledge scores were very high (X=4.08 on five point scale) and positively skewed, thus not lending much information to differentiate participants.

7.2 Dependent measures

7.2.1 Friendliness of site

On a Likert scale of 1-5, participants were asked to assess the friendliness of the site. There were no statistically significant results in the 2-way (navigation mode, distractions) ANOVA with site friendliness as the dependent measure. As would be expected in considering all of the participants (who represent all four web site combinations), participants' confidence in navigating the site was positively correlated to their reported friendliness of the site (r=.411, p <.0001).

7.2.2 Attribution of disorientation

On a Likert scale of 1-5, participants were asked the following: "Consider the times when you felt disoriented during the task. Overall, do you attribute your feelings of disorientation to your self or to the web site? (with 1 representing to the self and 5 representing to the web site.)" This question served to assess to what extent participants attributed (i.e., blamed) navigation problems on the web site as opposed to themselves. However, there were no statistically significant results in the 2-way (navigation mode, distractions) ANOVA with attribution of disorientation as the dependent measure.

7.2.3 Disorientation with site

Level of disorientation was determined from ten Likert-scale questions from Beasley & Waugh's Non-Linear Media Disorientation Assessment instrument (Beasley & Waugh, 1995). As expected, participants' disorientation scores correlated negatively to systems knowledge (r=-.253, p<.05), interest in content (r=-.351, p<.005), and confidence in navigating (r=-.605, p<.0001).

From a two-factor ANOVA (navigation mode, distractors), there was a marginally significant main effect for navigation type (F=3.318, p=.07), where those in linear condition were more disoriented (X=13.58) than those in nonlinear condition (X=10.63). This indicates that participants feel more oriented with a nonlinear web site format as compared to a linear format.

7.2.4 Main point of passage (1-5)

Participants were asked to state the main point of the passage. Items were scored on a 1-5 scale, with a representative answer receiving a "1" as "It provides a general discussion about the web." and a representative answer receiving a "5" as "It analyzes the possibilities the web offers to educators and its importance as a learning tool."

From a two-factor ANOVA (navigation type, distractors), there was a statistically significant interaction of navigation type and distractors (F=4.70, p<.05) for the main point score. This interaction indicates that participants performed better in the linear condition with *no* distractors (X=3.63 vs 2.62), and in the nonlinear condition *with* distractors (X=3.56 vs 3.42). Perhaps the distractors in the nonlinear condition forced subjects to expend more effort in discerning the meaning of the passage and were thus beneficial. In contrast, in the linear condition, the presence of distractors negatively affected performance by not fitting in with the linearity of the passage navigation.

7.2.5 Benefits of using web for education (0-9)

Participants were asked to "list as many benefits of using the web for education as possible, according to the web site." They were awarded one point for each benefit listed that was stated in the passage. The range of scores was 0-9, with the mean as 3.34 (sd=1.97).

A two-factor ANOVA (navigation type, distractors) indicated that there was a significant main effect for distractors (F=6.68, p=.01), where those in web sites with *no* distractors (X=3.90) performed better (listing more relevant benefits) than those *with* distractors (X=2.76). This indicates that the presence of distractors negatively affects idea production (in the form of listing benefits) following the learning experience. Perhaps the distracting links distracted the participant from focusing on and then later recalling passage content.

7.2.6 Confidence on this site

There were no statistically significant results in a 2-way ANOVA where confidence in navigating the experimental web site was the dependent variable. As expected, there was a strong negative correlation of perceived disorientation with confidence in navigating the site (r=-.605, p<.0001). Interestingly, females reported more confidence navigating the site than males (X=4.68 vs X=4.26, p=.001), yet they also reported more overall disorientation with the site (X=10.52 vs 13.24; p=.07).

7.2.7 Interest in topic

There were no statistically significant results in a 2-way ANOVA where interest in passage content was the dependent variable.

8.0 Discussion and implications

The first prediction, that preference for sensation-seeking behavior and spatial-holistic ability factors would influence perceived disorientation and navigation site, was not supported based on analysis of the data. However, there was a marginally significant difference in main point scores between those (N=36) with high spatial-holistic scores (X=3.51) and low spatial-holistic scores (X=3.06, p<.1), thereby indicating that spatial-holistic ability facilitated discerning the main point although did not interact with other navigational factors.

In terms of the second prediction, three findings regarding motivation, orientation, and learning will be briefly discussed.

First, in terms of motivational factors regarding navigation, there is a clear connection between perceived web site friendliness and perceived orientation within the site.

Second, in terms of web site and interface construction, this study indicates that participants feel more oriented with a nonlinear web site format as compared to a linear format. As would be expected, it was found that perceived disorientation was highly negatively correlated to both site friendliness and confidence in navigation.

Third, when factoring in learning from the web site (or other open-ended learning environments), it was found that recalling examples from the text (e.g, benefits of Internet use for education) was facilitated when the site had no distracting links. However, when the navigation mode was nonlinear the presence of distractors was not necessarily bad for influencing participants' conception of the main point of the passage. An important caveat is that the participants' task was not to learn the passage; consequently, the two learning measures (stating the main point of the passage, and listing educational benefits of using the Internet) actually assess incidental learning. Overall, this evidence begins to suggest that participants may indeed learn more from a nonlinear than a linear navigation mode. It is not clear whether or not the role of distractors, or "seductive" links, negatively affects learning. Future research should include more comprehensive learning measures.

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The Development of Simulation Models of Plant Systems as a Bridge Between Current Scientific Research and Students or Teachers

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Abstract: Plant science is crucial to understanding our natural environment and agricultural systems. The scientific method is a vital part of scientific literacy, and can be effectively presented using simulation models as the experimental setup. We describe the design as well as some of the challenges we faced in two projects aimed at making current plant science available for classroom and independent educational use in the form of interactive simulation models.

1. Introduction

Science education is critical to our future as the youth of today become decision makers of the next century. Without the ability to understand and interpret scientific discoveries and developments, young people today will be unable to make informed decisions as they face the challenges of the future. As studies show that science literacy among the general public is weak, there is a critical need to help young students better understand what science is all about. This includes building closer ties between current research and the general public. In addition to imparting knowledge, we need to help teach scientific methods as they are practiced today, and to motivate students to both care about scientific study and have a desire to participate.

Computer technology and the Internet could play an important role in achieving the transfer of scientific research out of the laboratory. Computer simulations are important scientific tools that play roles in our lives such as predicting future climates, estimating the spread of diseases, and setting limits on exposure to toxic substances. The challenge in using computer technology in education is to create high quality and effective learning experiences [Weller 1996]. Programs based on scientific methods of inquiry, like computer simulations, can help students learn how to apply such methods to other fields of study [Regian & Shute 1994].

Plant science, in particular, is vital in understanding our environment, both natural and agricultural. Yet plant science only receives a small fraction of the time allotted to science in secondary schools. The Plant Modeling Group of the Boyce Thompson Institute for Plant Research (BTI) is working to facilitate the transfer of exciting plant research to classrooms and the public at large. This paper discusses our design approach for developing simulations used in two related educational projects.

2. Project Descriptions

The first project, funded by the National Science Foundation's Informal Science Education (ISE) program, involves creating a Web-based activity allowing visitors to experiment with plants from different climates in different growth conditions, to observe the response of plants to water stress. This activity consists of a multimedia tutorial on basic plant physiology and an interactive simulation of an experimental setup that presents the user with virtual tools to investigate plant responses, much like a real laboratory.

The ISE project's model simulates the water use of a growing woody shrub. Two shrubs with different tolerances for water stress are available to the student. The student picks shrubs for inclusion in a virtual growth chamber, and sets the humidity and watering schedule. The model, through a series of mathematical relationships governing water uptake, transport, and loss through transpiration, predicts the carbon uptake and hence the growth of the plant. The model simulates the breakdown of water conducting tissue in the plant

during drought conditions, and maintains several daily values. The student can go to any point in time during the simulated growth of the plant and take virtual measurements of these daily values. From there they attempt to draw conclusions from the experiment or ask new questions.

The second effort in progress (IMPACT-Interactive Models of Plants to Augment Classroom Teaching) is a foundation-funded pilot study to develop a series of computer simulation models that allow hands-on experimentation in the classroom. This series is designed for CD-ROM with possible Web links to supporting material. The models incorporate current research findings into "virtual laboratories" where students are able to explore and experiment with plants and ecosystems.

A tropical forest restoration experiment in Costa Rica is the first scientific research study we have translated to a simulation model. We created a spatial model of tropical forest succession which tracks the height growth of up to 12 species of native trees across a rugged landscape. The student attempts to achieve a diverse mature tropical forest by first planting pioneer species to establish shaded plots and soil stability, then planting other, shade tolerant species, and species to eventually replace the pioneer trees. In the model, the trees compete for light and nutrients and grow in response to their immediate environment and their genetic abilities.

The projects have in common an emphasis on experimental design and the scientific method, in this case the experiments being conducted by changing parameters within the simulation. The critical feature of providing an interactive experimental model as part of the educational software is that it provides an open-ended, exploratory educational experience. It allows an unlimited number of outcomes and can convey the uncertainty that is usually present in experimental research, and it can often raise additional questions while answering others. Therefore, is in even more important for the student to have a clear and answerable question, or hypothesis, in mind as they begin a simulation experiment.

The two efforts differ in the intended audience and learning environment. The ISE project is for interested students learning on their own, outside of a classroom, while the IMPACT project targets classroom teaching, from high school to early college level. The Web-based ISE project presented us with unique design challenges because it is delivered over the limited bandwidth Internet to a solitary user. We needed to provide more supporting material, including an animated tour of how to use the model to guide them along. By contrast, we aimed at making the IMPACT product adaptable to varying teaching goals and styles by making the model not as dependent on the supporting materials and providing a teacher guide.

3. Design Process

Project personnel include experimental scientists, plant modelers, educators, designers, and programmers. The models are created from the best scientific data available to us, and are derived from the same kinds of functions and assumptions that would be employed in actual research models. Out of necessity, much detail is left out compared to a research model, but we maintain the standard that the model should produce the expected result within its own realm of possible inputs. They are programmed in Java because of the language's advanced features, cross platform capability, and Web delivery capability.

Early feedback from members of our potential audience for IMPACT emphasized the importance of creating a flexible program that can be used in different ways. In one setting, the teacher may assign the science question and suggest the experiment to perform, while in a more advanced setting, the teacher may only provide broad goals for the students, and in still another scenario, the whole class may participate in a single model exercise. One method to achieve this is to have the model be capable of falling back on default numerical input values that make sense in the current context, so that not all model parameters need to be specified explicitly. It is also important to have enough background material available in the program for more independent work.

In creating the model, we had success with having the plant scientist build a spreadsheet model as a starting point, having the programmer re-create that spreadsheet using the software's built-in language (Microsoft Visual Basic), and using the result as a tool to interactively refine the model. The majority of the effort was expended achieving an acceptable model in this way; it did not take long to convert the result into Java code. However, for every line of code for the simulation itself, there were five lines of user-interface support code.

During the design process, we noticed a continual tension between the goals of communicating the science accurately and being able to reach a target audience of high school aged or younger students, perhaps working on their own. It is not clear how to overcome some of these formidable challenges. The model provides significant depth, however, for students motivated to work hard exploring several experiments.

There is a dichotomy between the experience we are trying to provide, which is discovery learning that requires reflective thought, and the computer interface, which is reminiscent of television or a video game. The latter suggests an experiential interaction where the user can be either passive or simply try to point and click their way to all of the information. A major challenge for us is to find ways to guide the student's expectations and actions to be more conducive to them being able to use the program as a powerful learning tool, posing questions, trying new experiments, and thinking about the implications of their results.

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SUPPORTING SELECTIVE VIEWS OF WEB RETRIEVAL RESULTS: AN INTERFACE AND EVALUATION

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Abstract: Perusal of textual displays of document surrogates produced by Web-based ranked-output retrieval services may require much user time, effort, and money. In this paper we present VIEWER, a graphical interface that allows visualization and manipulation of views of retrieval results, where a view is the subset of retrieved surrogates that contain a specified subset of query terms. We argue that VIEWER helps the user focus on relevant parts of the results and, in addition, it may facilitate query reformulation. We present an experimental evaluation in which VIEWER, used as an interactive ranking systems, outperforms both best match ranking and coordination level-based ranking.

1. Introduction

Search of document databases is an interactive process in which users submit a query, see the ranked documents returned in response to the query, and submit a new query, until either they are satisfied with the results or become frustrated and give up. While most research and commercial efforts have focused on producing effective systems for retrieving and ranking relevant documents in response to a query, little attention has been paid to ease the process of result inspection and query reformulation, especially in the Web domain.

Currently available search engines (e.g., Alta Vista, Excite) score queries against documents, compute the highest scoring documents, and present the user with a set of document surrogates in ranked order. While the display of surrogates should allow the user to make a quick and possibly accurate judgement about the relevance of retrieved documents without downloading the full documents, its utility is reduced by the lack of effectiveness of current retrieval engines' interfaces.

One main reason for users dissatisfaction is the use of standard similarity scores. Roughly, a document receives a higher score if the terms in the query are in the headline, if the terms appear many times, if the terms do not appear in other documents, or if phrases occur as they do in the query. These criteria are then combined in various ways and produce a final numerical coefficient. This numerical coefficient - the only global document characteristic provided by the system - is difficult for the user to evaluate and can be hardly used as an indication of whether the corresponding surrogate should be perused or not. Another related limitation of current Web retrieval interfaces is the lack of a concise representation of the content of all retrieved documents; conventional textual displays take much perusal time and screen space and does not enable inspection of more documents at a time. Given these characteristics of the interface, the inspection of Web retrieval results usually implies for the user to go through the document hitlist produced by the system, spending a considerable amount of time, effort, and money (for those systems that charge the user based on connect-time and the volume of downloaded data) for perusal of document surrogates.

One way to alleviate this problem is to develop a graphical interface that displays the characteristics of documents which are significant in supporting the decision to peruse or not, while giving the user more control over the set of document surrogates that can be selected for perusal. The need for concise display and user-oriented manipulation of retrieval results has been addressed by various systems. Among others, Bead [Chalmer and Chitsons 1992] and LyberWorld [Hemmje, Kunkel and Willet 1994] depict clustering patterns in a document space using three-dimensional visualization schemes, InfoCrystal [Spoerri 1994] uses a particular visual representation of a Venn diagram to suggest how to refine Boolean queries, TileBars [Hearst 1995] displays distribution of query terms within each document to locate its relevant parts. Most of the proposed approaches, however, cannot be applied to Web-based retrieval because they are either computationally expensive, or require sophisticated graphical facilities, or do not scale well, or rely on

different underlying retrieval models, or, more often, present a combination of these features. One notable exception is [Veerasamy and Heikes 1997]'s system. Its main goal is to clarify the role played by query constituents in the result of ranked output systems, it is computationally efficient, and it uses a relatively simple graphical display. Our approach shares a similar concern but employs a radically different visualization and interaction scheme. Instead of visualizing the weights of the query terms of each retrieved document and let the user select those of interest, as in Veerasamy's system, we concentrate on all the possible subsets of query terms (i.e., subqueries) that can be generated from the user query, showing their distribution in the set of retrieved documents and letting the user to select the associated set of documents. We speak of view, because in this way the user may see parts of results without seeing the whole list. Views are defined in a precise way from the retrieved documents through a simple and comprehensible characteristic of their content, i.e., the subset of distinct query terms that they contain.

In the rest of this paper we present VIEWER (VIEws of WEb Results), a system for seeking information over the Web based on view manipulation. VIEWER copes with most computational constraints of Web-based retrieval (e.g., efficiency, portability, adaptability) that are not usually addressed in other document visualization systems and can be used as an interface to currently available search engines. We argue that VIEWER can be used both for focusing on relevant items of the document hitlist returned by the search engine and for driving the process of query reformulation. A major part of this work is then an experimental evaluation of the former aspect. We compare the effectiveness of VIEWER, seen as an interactive ranking system, and that of two automatic ranking systems, namely the search engine to which VIEWER is linked and a coordination level-based system. The results of the experiment are encouraging.

2. Visualization and manipulation of Web retrieval results with VIEWER

VIEWER is built around available "primary" Web search services, presenting users with a single unified interface [Fig. 1]. Users enter a query, which VIEWER forwards to a selected search engine (Alta Vista, in the current implementation).

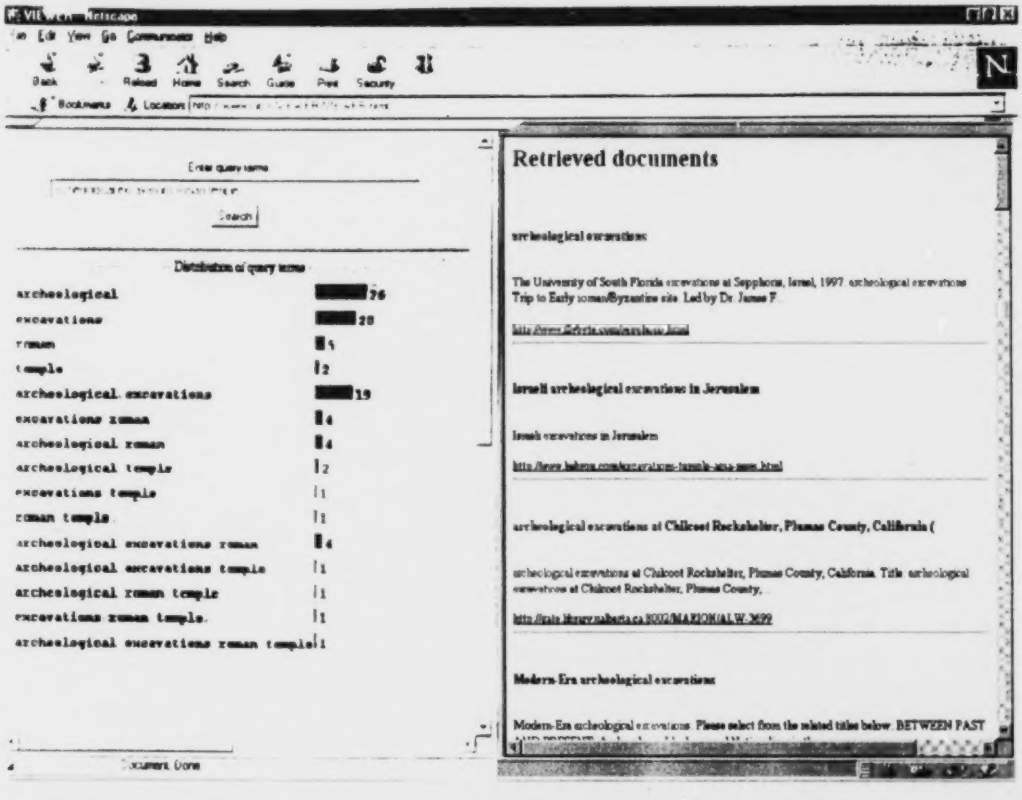

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Figure 1: Visualization of retrieval results with VIEWER. The graphical distribution of subqueries in the first 40 retrieved document surrogates is displayed. Clicking a horizontal bar brings up the associated document surrogates in the document window.

VIEWER then collects the query results and shows, in a scrollable window, a subset of the document surrogates, in the same ranked order as returned by the search engine; in addition, it shows, in the rest of the screen, a graphical visualization of results. The visualization consists of an aligned sequence of horizontal bars, one for each of the 2^n-1 nonempty subqueries that can be formed with the n query terms. Subqueries are displayed in the order of increasing number of terms, with the longest subqueries at the bottom; the length of each bar is proportional to the number of document surrogates containing that subquery, which is also explicitly displayed next to the bar[1]. By clicking on a bar the user may select the corresponding view, bringing up the associated surrogates into the document window. As an example session with VIEWER, consider searching the following subject: "archeological excavations for Roman temple". [Fig. 1] shows the response of the interface to the user query: *archeological excavations roman temple*, as of February 20, 1998. The graphical display quickly shows that the results produced by Alta Vista are, in general, dissatisfying, because most retrieved documents do not apparently deal with Roman temples. In fact, there is only one truly relevant document - the one whose surrogate contains all query terms, which is, incidentally, the eight item returned by Alta Vista - with most of the first 40 retrieved documents concerning archeological excavations of different kinds. VIEWER allows the user to select those few surrogates that appear to or might be relevant, without perusing the others. In addition, it suggests that if the user is primarily interested in "Roman temples", he or she should submit a new query that does not contain the two words: archeological excavations.

3. Utility of view display and selection

It is often the case that some subsets of query terms are so important for a search topic that they will appear in all relevant documents (e.g., the subqueries "archeological excavations" and "Roman temple", in the example given above). In this situation, we would like to ask such questions as: how many documents contain the subquery *s*?, which documents contain subquery *s*? Also, if subquery *s* is contained in too many documents, we would like to ask: which terms can be added to *s* in such a way that the resulting set of documents is more manageable? If, on the contrary, subquery *s* is contained in few documents, we might ask: which terms can be deleted from *s* in such a way that the resulting set of documents is still manageable? We might also be interested in the relationships between different subqueries. So we might ask: what is the contribution of subquery *q* compared to subquery *s*?, does subquery *q* occur more frequently alone or in conjunction with *s*?, and so on.

With conventional ranked output systems such questions would remain unanswered, because the logic behind the retrieval mechanism of these systems does not allow the user to understand how the query constituents influenced the retrieval results. By contrast, VIEWER's graphical display of subquery distribution together with the possibility for the user to choose the relevant views seem to allow a quick answer for such questions. In addition to enriching inspection of retrieval results with facilities for selection, comparison and refinement involving groups of query terms, VIEWER has also potentials for facilitating query reformulation. It may help the user detect that some term (or subquery) is much more frequent than others in the first retrieved documents, in which case the user may formulate a new query using a narrower term or adding a term that helps to specify its intended sense, or, conversely, it may show that some query term is very rare, which may imply using a broader term or deleting some other frequent term from the query. In fact, the latter information may be very useful in Web-based retrieval, because it is often the case that while there are thousands of retrieved documents that match some query term, none or very few of them is contained in the first pages returned to the user (as the subquery "Roman temple" in the example given above). The graphical component of VIEWER may also help detect failure of intended senses of words, i.e., when two terms used in the query to identify one particular meaning do not occur together in the retrieval results, or, symmetrically, discover unwanted senses of words [Cooper and Byrd, 1997].

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[1] It should be noted that some search engines, including Alta Vista, do full-text indexing. So it may happen that some query term is contained in the full document but not in its surrogate. However, given the ranking criteria described above, for best-ranked documents this is not usually the case.

4. Architecture of VIEWER

VIEWER is a client-server system with two main components: the user interface and the search manager.

The interface program is implemented as a Java applet in a Web browser, which can be downloaded with the web page *http://www.fub.it/VIEWER/VIEWER.html*. The user interface sends the user query to the server machine, which forwards the query to a selected search engine and then collects and parses the first pages retrieved by the search engine in response to the query. The server, then, sends back to the client the parsed retrieved document surrogates, which are used by the interface component to produce the information displayed by VIEWER on the client's screen. VIEWER's code can be easily modified to work with different search engines or to adapt to their interface changes. The number of collected pages is a system design parameter, currently set at four.

5. Evaluation of VIEWER

The goal of the experiment was to evaluate the effectiveness of VIEWER in help the user focus on relevant items of the document hitlist produced by a ranked output retrieval system on a subject searching task. We did not perform subject searching over the Web because it would be difficult to assess the system's retrieval effectiveness and do comparative studies in this unrestricted domain. Rather, we used a set of two to four term queries based on the 52 topics taken from the CACM test collection, an electronically-available bibliographical collection of 3204 documents widely used for laboratory tests. The queries were created by selecting terms from the topics and had an average length of 3.8 terms. We evaluated the performance of three ranking methods: WAIS, coordination level-based ranking and VIEWER.

WAIS is a classical ranked-output retrieval engine. We chose WAIS because it can be used for indexing and searching site specific information, as opposed to global Web search. We connected the WAIS server to the CACM collection and executed the 52 queries against the corresponding WAIS database.

Coordination level (CL) is a well known retrieval method that ranks the documents according to the number of distinct query terms that they contain, which is referred to as their coordination level (see for instance [Van Rijsbergen 1979]). Coordination levels therefore resemble of views, but should not be confused with them: a coordination level contains all views with a same number of distinct terms, regardless of the actual terms that describe each view. The CL method automatically returns a complete ranking. If the user query contains *n* terms, the documents that contains n query terms are ranked before those containing *n-1* terms, which, in turn, are ranked before those containing *n-2* terms, and so on. As CL produces a partly-ordered retrieval output, we further ranked the (equally-ranked) documents within each coordination level by using the ranking produced by WAIS for those documents. The 52 queries were then executed over the CACM database using overall ranking.

VIEWER cannot produce a ranking by itself, but it can be used to help users build their own document ranking. We designed an interactive procedure that was executed by six subjects. The subjects were recruited in our institute; they had a computer science background with little knowledge about the document domain. The procedure for building the interactive ranking works as follows. Each subject was shown the topic, the query extracted from it, and VIEWER's visualization of the distribution of query terms among the documents returned by WAIS in response to the query. Then the subject was asked to choose a sequence of views by repeatedly selecting one of the views offered by VIEWER until all views had been selected. The documents were thus ranked according to the order chosen by the user to select the views. Documents contained in more views were ranked based on the earliest view in which they occurred. As with CL, we used the ranking produced by WAIS as a secondary ranking procedure to rank the documents within each view. As a result of this process, the final ranking built by the user corresponds to a particular sorting of the documents contained in the output returned by WAIS. Each subject took about one and a half hour to execute all the 52 queries.

The results are displayed in [Fig. 2]. The precision-recall curve is normalized considering, for each query, only the relevant documents that contain at least one query term; i.e, those that are actually retrieved and ranked by the three methods. The [Fig. 2] reports interpolated precision at eleven recall levels, averaged over the 52 queries; the results of VIEWER are averaged over the six subjects. [Fig. 2] shows that the performance of VIEWER was better than WAIS and CL, which, in turn, was better than WAIS. The better precision of VIEWER over WAIS and CL, and of CL over WAIS is apparent at almost all the recall levels. A paired *t*-test

performed over the whole set of data (i.e., values of precision for all queries at all recall levels) revealed that the difference between VIEWER and CL and between CL and WAIS were not statistically significant (p = 0,15 and p = 0,10, respectively), but it did confirm the superiority of VIEWER over WAIS (p = 0,04). These results therefore support our main claim that views selection allows the user to extract relevant documents from the output returned by best-match search engines. In addition, our results show another interesting and somewhat less expected phenomenon.

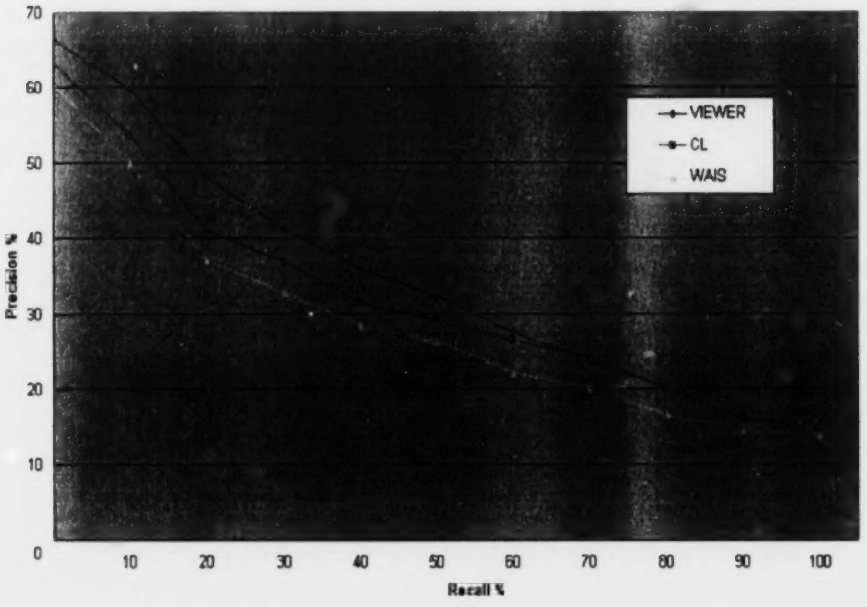

Figure 2: Precision and recall graph for the CACM test collection

That the performance of CL was better than WAIS might, in effect, seem counter-intuitive, because best-match retrieval methods are generally considered to be more effective than exact-match retrieval methods, including CL. However, some evidence has been recently reported [Clarke, Cormack and Tudhope 1997] that shows that coordination level-based ranking performs better than best-match ranking when the user queries are short. In this respect, our results confirm these earlier finding on a different test collection; also, they suggest that interactive subquery ordering may be more effective than automatic ordering based on coordination level, although we should emphasize that [Clarke, Cormack and Tudhope 1997] employ a method for ranking the documents within a coordination level that is different from ours. The main reason for justifying the superiority of the interactive method over the automatic one is that the latter is a purely syntactic method. The automatic method therefore fails to recognize all the situations in which documents containing fewer query terms are more relevant than documents containing more query terms. This usually happens when there is a short subquery that corresponds to a concept that is relevant to the subject being searched while other longer subqueries are theoretically available that do not convey a precise meaning. For instance, one of the CACM topics was: "optimization of intermediate and machine code", which was translated into the four term query: "optimization intermediate machine code". It is clear that while "code optimization" is a relevant subquery for the topic, there are longer subqueries that are less relevant ("intermediate machine code") or even meaningless ("intermediate machine optimization"). This problem is made more acute by the fact that there is no simple way of dealing with such lexical items as initials, acronyms, and proper nouns, which frequently occur in user queries. In our experiment, it was often the case that users favoured shorter subqueries. In particular, for a significant percentage (27%), the users applied a view which would have not been selected by the syntactic method.

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6. Limitations and future work

The visualization component of VIEWER works with a limited number of query terms (in the current implementation, up to four), because the display of the subquery distribution in the retrieved documents would become cumbersome for longer queries. In practice, however, this may not be a serious limitations, for it has been often remarked that, at least in Web settings, queries to text retrieval systems are usually extremely short, often containing no more than two or three terms [Rose and Stevens 1996; Clarke, Cormack and Tudhope 1997]. Another important design parameter of VIEWER is the amount of textual information extracted from the retrieval results and used as input data to the interface. For each query, VIEWER processes only a limited subset of the document surrogates returned by the search engine, where each documents is usually described by a few tens of terms. Of course, it would be useful to work with more documents and more terms per document. However, increasing the number of terms per document is unfeasible unless we download the full documents referenced by the search engines, which would take an exceedingly long time, while increasing the number of document surrogates can only be done at cost of significantly slow down the response time, although such an additional time cannot be exactly estimated. Since the computation time required to build the visualization scheme is negligible, taking no more than a few seconds, the key parameter for VIEWER's efficiency is the search time. With a few tens of document surrogates, the total response time of VIEWER is usually fairly acceptable.

This research can be extended by further exploring the issue of the utility of graphical displays of Web retrieval results on more robust and realistic basis. The experiment reported in this paper has taken a first step into this somewhat overlooked direction, but our results can only be taken as indicative and much more work is needed. As suggested above, one factor that needs to be controlled for evaluating the efficiency and effectiveness of this kind of systems is the fraction of retrieval results used by the visual interface. In operational situations, however, there may be other important parameters that affect their overall utility. We plan to perform further experiments to evaluate how the performance results change when controlling a wider range of factors including database scale, query length, and possibility for the user to formulate more queries.

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A Course on Using the Web for Marketing: Design and Early Reflections

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Abstract: This article describes a Marketing elective in the Business School which integrates technology into the curriculum using a series of assignments in which analysis of Marketing Communications is taught using HTML, PowerPoint, and Web Board, an on-line conferencing system. Students learn to analyze Marketing Communications and later to develop Web sites that are strategically sound. Other software which is taught for use in Marketing Communications includes Paint Shop Pro and Wave Studio. The final project for the course is a Web site for a fictitious company as well as a paper that explains the marketing strategies, tactics and rationale for the site.

Background

The Lubin School offers a variety of majors in the business disciplines. This paper deals with an interdisciplinary, collaborative effort on a Marketing elective course that teaches students about Marketing Communications on the Web and is entitled *Strategic Internet Marketing.* While the technical component does not include in-depth study of any of the programs, it does provide students with the knowledge and skill to design relatively simple Web sites. Although students are given some hands-on experience with the software and are required to do assignments demonstrating some proficiency, the long range goal is to give them enough experience to be able to direct the building of a Web site both from a strategic and an operational point of view. E-mail and the university on-line conferencing system, called Web Board, are used to support and extend classroom instruction.

Students must (1) use e-mail, (2) participate in on-line conferences on the subject matter of the course, (3) practice using basic HTML (4) make presentations using a PowerPoint (5) use a drawing program (Paint Shop Pro) to manipulate an image, and (5) create a simple sound file using Wave Studio.

Course Objectives

- To learn how companies use the World Wide Web for marketing.
- To apply established and emerging concepts from marketing to the analysis of Web sites.
- To construct Web pages using HTML, Netscape, Paint Shop Pro, and Wave Studio.
- To prepare and give a presentation using PowerPoint as well as communicate informally and
- To exercise and strengthen their critical thinking skills.

Course Structure

The course is taught on two days. A two-hour session on Mondays is held in a computer classroom. An important feature in this classroom is the ability to project the teacher's station or any student station to everyone's screen. On Wednesdays, there is a one-hour session in an ordinary classroom devoted entirely to marketing work.

Course Assignments

The course has two major homework assignments and a final project. In the first assignment, students analyze a company Web site and present their analysis in the form of a Web page. They use HTML and incorporate images and links. The instruction in HTML is done by giving students an HTML document in source form with corresponding hard copy of the display form. This hand-out includes questions which must be addressed in their Web site analysis, including type of business, purpose of the Web site, communications strategy, target market, and the like. Students are also asked to reflect on their experience viewing the site and maintenance issues.

In the second assignment, students compare advertisements from magazines with company Web sites. The students should include in their analysis the target market, the message, offers to customers, visitor information and overall marketing objectives. In addition, students are asked to analyze design elements, such as the layout scheme, images, graphics, icons, links and the like. Students are asked to look at these design elements in terms of their ability to "execute" or support the strategy. As with the first assignment, this one serves multiple purposes. The comparison and contrast exercise deals with the subject of Marketing, but the vehicle of expression is a set of presentation slides developed using PowerPoint which students then use in their classroom presentations.

The third assignment is to plan a campaign involving a Web site. This is a team assignment and the requirements include a preliminary presentation to which the rest of the class gives constructive feedback in class and through Web Board, a final presentation in class and a written final report. The teams are cautioned to pay attention to the integration of the Web site with other forms of promotion, and not focus exclusively on Web page design. A storyboard or layout for the site is required with a statement of the rationale for key elements of the site.

Reflection on course

The Web is a new, evolving medium. It is an essential for anyone who expects to be involved with communication to become acquainted with it. Advertising on the Web is growing with expenditures in 1997 reaching 900 million dollars, a 300% increase over the previous year (Higgins, 1997).

One challenge, of course, is that it is difficult to maintain the proper amount of control in a busy classroom. Web sites themselves are very busy and interactive. Further, it is very easy to get distracted or become focused too much on the use of the technology and not on the content itself. Team teaching has the positive benefits of sharing the responsibility and allowing each professor to contribute. The teachers are learning from each other and, therefore, are modeling life-long learning for the students. There is a de-centering of the classroom that can allow students the opportunity to take responsibility for their learning. However, time in classroom continues to be a challenge given the wide range of knowledge in marketing and technology. Professors must strive to find a happy medium, so that the course is a successful learning experience for all. On-going efforts include building a web site to provide support for students and to post exemplary student work (http://csis.pace.edu/~meyer/mar396ws.htm).

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From Syllabus to Infinity: The Gradual Implementation of Websites

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Abstract: There is an alternative to the all-or-nothing approach to website design. The purpose of this article is to provide an example of a gradual website implementation and to list guidelines for future incremental website design. By separating a project into phases and following some simple guidelines, it is possible to create an effective website and then improve it systematically.

Introduction

When I began teaching a computers in education course, I was a WWW novice. Before classes began, part of my job responsibilities was to put my course syllabus on the Internet for students to access. The thought of putting course materials on-line frightened me, so I decided to start small and grow from there. I began with a simple syllabus on the Internet and now, after five semesters, I have a complete course website with an interactive calendar, class notes pages, project descriptions, and Internet course resource links. Additionally, there are links for student to log onto the class discussion forum, to view class sample files, to turn in finished class assignments, to check their university course grades on-line, and to fill out course evaluations. The purpose of this article is to describe this example of a gradual website implementation and to list guidelines for future incremental website design.

Example of Gradual Website Implementation

Faced with the necessity of creating a course website, I had two main limitations: a lack of time and a lack of knowledge of web authoring. This made a gradual website implementation vital. The implementation took place in four phases in which I focused upon (1) the bare essentials, (2) daily class notes, (3) an inter-face-lift, and (4) continual polishing.

The first semester I decided to simply put the bare essentials on the website and to have the rest of the website emerge from the needs of my students. One of my colleagues generously allowed me to use the interface he had used for other courses as a basis for my own. My simplistic website included a main page with links to my course syllabus and scant page of links to useful web resource sites, such as html guides, teacher websites, etc.

During the second semester, I decided to focus on putting daily class notes pages on the website. Since there were approximately 45 class meetings, this meant a considerable effort and a large number of new webpages. I decided to modularize my website by creating separate directories for different types of webpages. This modularization made it easier to find the different types of pages. I also made a template for the class notes pages so that they would all have the same format. Since the repeated text and format was included in the template, it saved much time and also increased the consistency between the webpages.

By the third semester, the website had the majority of its functionality. The only problem was that the interface I was using was still not my own. I decided to give my course website an inter-face-lift. I began by thinking about the theme of my class—unraveling the computer puzzle. I used the puzzle theme throughout

the graphic design. The existing pages had black text and a white background. Therefore, I just added colorful puzzle piece images to the tops of the pages. I saved time by just adding one new tag to the pages rather than making major changes to each page. I began the semester by making changes only to the menu and the webpages which were used during the first few weeks of class. Then, every week I would change the format of the class notes and project descriptions for the following week. By the end of the semester all the pages were updated with the new interface features with a minimal time investment of five to ten minutes each week.

It seems to be the nature of website implementation that there are always little things to improve. My class website is no different. Each semester I add new content or functionality to the website. For example, one semester I added assignment instructions to the bottoms of the daily class notes. Another semester I added grading criteria or rubrics to the class notes. Since I never seem to have a large amount of time to devote to my website, I gradually make changes over the course of the semester, beginning with the earliest pages and continuing until the end. After five semesters, the changes are now minimal updates to information.

Guidelines for Gradual Implementation

Over the past few years, I have been involved in additional website implementations both in corporate and educational settings. Through this design experience, I have found several guidelines can facilitate the gradual implementation process.

Keep It Simple: Focus on the content and necessary functions of the website. Focus on those web features which are efficient, effective, and within your capabilities. Add new webpages on as they are needed so that you don't have links or pages which are never used. Keep designs for the various menus and content pages as simple as possible to facilitate easy upgrades and changes. Remember that fancy features may give your programming ego a boost, but they may distract users and they might take hours to debug.

Have Reasonable Goals: Set reasonable goals for completing phases of the website. The key to gradual implementation is to be able to make updates with just a few minutes of time each week. Avoid the temptation to make major upgrades in the middle of the process. Those can be integrated into the next iteration.

Keep It Consistent: There should be an overarching consistency of form for a given website. This is usually developed as a visual theme. This visual theme should include the way in which similar pages of content are designed, the use of color, the use of font or heading styles for emphasis, the way in which links are marked, the graphics design, etc. One of the easiest ways to ensure that similar webpages have consistent appearances is to use templates. These templates can contain the repeated structures for a given type of webpage. For example, they can contain the tags for repeated graphics, website navigation links, author/copyright information, repeated headings, tables, or text, etc.

Have a Modular Construction: Modular construction refers to the way in which files for a given website are organized. When developing or redeveloping a website, it makes the programming process easier when related files are located in the same directory. This makes it easier to move from one file to the next without having to navigate through various website directory levels.

Keep a Web Notebook: Perhaps one of the most understated guidelines for gradual website implementation is to keep a notebook containing printouts of all the webpages in the website. This makes it possible to note changes or improvements which should be made in later stages of the implementation.

Keep Content General: The key to having a reusable website from semester to semester is to keep content free of specific references to textbook page numbers, dates, etc. If it is absolutely essential to include such

specific information, it would be helpful to highlight that information in the web notebook so that it is easy to find and change in future semesters.

Some Final Thoughts

When time or programming knowledge are limiting the development of a complete website, a gradual implementation is in order. By separating the project into phases and following some simple guidelines, it is possible to create an effective website and then improve it systematically. As the old saying goes, "By the mile it's a trial, by the inch it's a cinch."

The ABC's of Web Interface Design

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Abstract: After learning a short list of HTML tags, novices with Internet accounts are able to place their own pages on the World Wide Web (WWW). While these novices may have the technical tools to create a website, their lack of design skills often results in the creation of websites which are difficult to use. A new field called web interface design has arisen to guide designers with regard to the navigation, programming, and visual design of websites. This paper focuses on visual web interface design and outlines the ABC's R' US visual design principles. (15 print and WWW references)

Introduction

Internet usage in the past decade has grown exponentially. After learning a short list of HTML tags, novices with Internet accounts are able to place their own pages on the World Wide Web (WWW). While these novices may have the technical tools to create a website, their lack of design skills often results in the creation of websites which are difficult to use.

> If you've spent much time exploring the Web, you've almost certainly encountered some badly designed Web sites. Since almost anyone can create Web pages, it's not surprising that many sites are confusing, overwhelming, ugly, or incredibly slo-o-o-ow. Tantalizing content can be hidden forever from the world when a site is poorly designed [Ben Benjamin quoted in BUILDER.COM - Webgraphics - elements of Web design, 1998].

Websites with poorly designed interfaces are simply not viable. In order to help novice designers increase the effectiveness of their websites, a new field called web interface design has arisen. This field addresses the navigation, programming, and visual presentation issues specifically related to website design. This paper addresses the third issue of web interface design–visual design It describes research sources for visual design, and summarizes the over-arching design with the ABC's R' US visual design principles.

Literature Review

The ABC's R' US visual design principles for web design are a synthesis of three main sources of research: interface research, visual design research, and web design guidelines. While the two former types of research were derived from printed research (articles and books), the later category is based more heavily upon online web design guidelines which are available via the WWW.

Interface Research

Interface research deals with the design and testing of human-computer interfaces [Apple 1989; Cates 1994; Laurel 1990; Nielsen 1990; & Shneiderman 1992]. Its link to visual design revolves around the consistency between the content, the media, the functionality, and the metaphoric theme of a multimedia product. Instructional designers can use this research to help them develop a product which supports clear and consistent interaction between the user and the computer program.

Visual Design Research

Visual design research addresses the visual principles used in interface design. These heuristics are extensions of the ancient Greek aesthetic principles of symmetry, order, emphasis, unity, and balance. These principles have been extended to also include proximity, and parsimony [Heinich, Molenda, Russell, & Smaldino 1996; Reilly & Roach 1986; Williams 1994]. Instructional designers can use these principles of aesthetic visual design decrease feelings of stress among learners and increase feelings of confidence and stability [Rambally & Rambally 1987; Reilly & Roach 1986].

Web Design Guidelines

Certain web design guidelines relate to the visual design of the layout [All Things Web, Apple Web Design Guide, BUILDER.COM - Web graphics - elements of Web design, Improving Web Site Usability and Appeal, Top Ten Mistakes in Web Design, Yale C/AIM Web Style Guide]. The focus of these guidelines is the appeal and ease of use of webpages. The main visual design principles resulting from these guidelines relate to consistency, simplicity, and utility.

The ABC's R' US Design Principles

The visual design principles which appear in the three above-mentioned types of research, were selected and sorted into synthesis categories (the entire data set included principles from over 125 print resources and over 30 online resources). The results summarized the data into seven categories or overarching principles: alignment, balance, contrast, chunking, repetition (theme), utility, and simplicity (by taking the first letter of each word, one forms the acronym "ABC's R' US"). These seven visual design principles should be followed for effective visual design.

Alignment: Alignment refers not only to the alignment of text, but also to the alignment of all visual objects. Objects have six points of alignment: right, center, left, top, middle, and bottom. The eye can perceive the strongest alignment when objects are aligned on the outer points on the right, left, top, and bottom. All text and visual objects should be aligned with one another.

Balance: The center of a page or a screen is its fulcrum of balance. In order to maintain visual balance, the weight of the objects on the left side of the webpage should be relatively equal to those on the right side and the objects on the top half of the webpage should be relatively equal to those on the bottom half. On a light background, objects which are darker have more visual weight than those which are lighter. On a dark background the opposite is true.

Contrast: Contrast is the level of difference in appearance between objects. Contrast can be achieved by placing a dark object by a light object or by putting a thin-featured object by a thick-featured object. In order to draw attention to an object, it should have a high level of contrast from its surrounding objects. The key to effective contrast is to use it sparingly. If one object stands out on a page or on a screen, it will draw the learner's attention. If a number of objects contrast on a page or on a screen, they can distract or even confuse the learner.

Chunking: Visual chunking refers to the placement of objects. Objects which carry out similar functions, such as navigation buttons, should be chunked or placed in the same visual zone of a page or a screen. Likewise, text headings should be chunked with the text which supports them.

Repetition: Repetition has many related layers. It refers to the consistent use of objects, effects, fonts, sizes, styles, and colors both on an individual page or screen and also throughout the product as a whole. Repetition also refers to the metaphor or theme used throughout the product. In this sense, all objects should support the same visual message.

Utility: Utility refers to the usability of the visual interface. It should be clear to the learner which objects are interactive and where the learner is located within the instructional product.

Simplicity: Simplicity addresses the appropriateness and the necessity of the visual objects on a page or on a screen. The purpose of visual objects is their instructional value not their impact value. Objects which do not support instruction can detract from learning. The key is to keep the visual design simple and only include those visual objects which are necessary to convey the instructional message.

Conclusions

The ABC's R' US visual design principles represent a summary of design research in order to present novice users with heuristics to guide effective web design. In this manner, they are descriptive of the current research in the area, while, at the same time, they indicate prescriptive heuristics for design. While it is not within the scope of this short paper to discuss applications of the principles to actual design projects, it is this author's hope that such applications will be discussed in the future.

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Top Ten Mistakes in Web Design: http://www.useit.com/alertbox/9605.html

Yale C/AIM Web Style Guide: http://info.med.yale.edu/caim/manual/

ISEC: A Human-Centred Web Site

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Abstract: In this paper we will describe the proposal Web site to ISEC (Instituto Superior de Engenharia de Coimbra). It has been set up with the aim of stimulating at the cultural change needed to transform the Institute, in the long run, into a learning organization.
We will describe the solutions that have been found to adapt to those requirements the architecture and management of the site. Although designed for general use, it can be explored in a large number of strictly educational tasks because it has been developed with organizational and cultural factors in mind.

1. Introduction

A learning organization is an organization that gives maximum priority to the aim of learning – an organization that is continually expanding its capacity to create its future – so as to be able to continually improve every facet of itself, its products and its services [Senge 1990]. Models for learning organizations change cultures focused on performance enhancement and decentralized management structures [Kotter & Heskett 1992] are now just beginning to be adapted by many companies. In learning organizations, both the individuals and the organization, as a whole, commit themselves to trying to become better every day, employees feel a renewed commitment to their work, and customers fill better served and satisfied. This philosophy is becoming increasingly widespread in enterprises. However, though higher education institutions have as their primary goal that of supplying learning, they paradoxically tend to be the absolute opposite of learning organizations, in the sense that they stress individualism, internal competition, and a major disregard for patient, widely shared, daily improvement. One of our concerns went to creation of the friendly interface through the uses of traditional icons, distributed in a discreet way and visually attractive. In Figure 1 we can see the front page of the site.

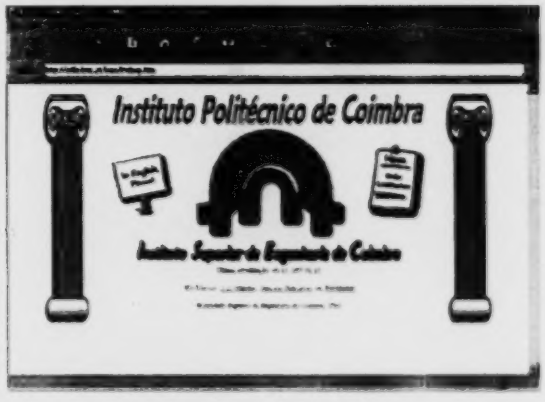

Figure 1: FrontPage of the site.

2. Some Features of the Site

We will describe the solutions that have been found to adapt ISEC to those requirements, in the long run. Unlike most sites developed for educational environments, whose requirements tend to be established almost uniquely on technological grounds - this one has been developed - from the very beginning, with organizational and cultural factors in mind. Although designed for general use, it can be explored in a large number of strictly educational tasks, since it includes the facilities of most sites built for interactive learning environments [Carlson et al. 1996].
The major features of the site, so as to comply with those requirements, are as follows:
Personal pages: To make possible the creation of personal pages by users with no knowledge of HTML a uniform pattern has been established for all the personal pages, granting the user interface coherence for all personal pages.

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This has been implemented as a Perl script that produces on the client's browser a Perl-generated form from which the page is automatically created upon completion of the form by the user.

Gradings: The students have the possibility of consulting his gradings online by simply supplying a password that gives access to the student's process. This is done by resorting to another Perl script that checks username and password, validates them against the corresponding values on an encrypted password file. This is similar to the Unix passwd file, and, if the whole security check is positive lets the student enter a page containing all the grades received, discriminated by course. Each such page is a private space that can only be viewed by each student.

Organization and presentation of the information regarding the courses: To establish the standard pages for the courses, a questionnaire has been sent to all teachers, requesting all the relevant information. This information provided a description of the course, teaching staff, syllabus, summaries, and recommended bibliography. Also any additional documents and transparencies, software available (so that it could be made available by ftp), project work carried out in the past and programmed for the future, relevant internal and external Internet links, exams (preferably with corresponding answers) and finally a FAQ, are provided. See Figure 2 for an example.

Figure 2: Example of one course.

Forums. In order to establish opportunities for open interpersonal exchanges, the site includes a forum divided into a variable number of themes. User friendliness has been a major concern, so, instead of setting up a standard *news* like interface, the forum system has been set up as a Perl script that automatically constructs the evolving HTML page that registers the evolving discussion. The forum also includes text and pattern searching capabilities.

Tool of Statistical Analysis. At same time it was built a statistical tool (WebReport), based in logs generated by the server, to analyze the information of the number of accesses to the site separated by categories, origin address, pages visited, time spent, browser used, etc.

3. Conclusions and Future Work

Building learning organizations involves developing people who learn to see, who develop their own personal mastery, and who learn how to surface and restructure mental models, collaboratively. We believe that the aim of building up an institutional Web site that contributes to promote the cultural change required to move our Institute into the direction of learning organizations has been achieved.

In future developments of the site, further automation will be introduced, namely by extending the principles used for automating personal pages and forum management to other key areas, such as the automatic production of tests by teachers, and the production, by students, of the corresponding individual answers. It will also be extended to the construction of course pages, grading sheets and administrative information coming from the Institute's Administrative Services. This is the new image of one institution that could involve all of their elements to participate more and better in the diversity of activities that are taking place at ISEC, and the new image of our Institute that we would like to promote for the next century.

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Learning Through Design-oriented Experience With Technology

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Abstract: Design-oriented activities with technologies are powerful tools for students' learning. This panel presents the views of using educational multimedia technologies in classroom learning among elementary, middle school and high school students. There are three hands-on design projects: 3D graphic design, Lego-Logo construction and programming of Robots, and Web site creation to demonstrate what students have created and completed. From the literature review and research, it is known that design-oriented experiences can provide opportunities for students to gain the abilities of active participating, higher-level thinking, creative problem-solving, interdisciplinary usage of knowledge, and interactive reflection of ideas. Particularly with new technologies, students engage themselves in the authentic design activities to learn the subject concepts such as math, science, and the arts together with the computer software and Lego bricks and blocks.

Multimedia & Distance Learning

The purpose for young students to create a Web site and put their finished work online is to provide them with design-oriented experience. Because students who got involved in both 3D and Lego-Logo learning activities are from different school districts, the Web site they created would be not only valuable resources for schools as a virtual community, but also good examples to stimulate further involvement of more students in learning new technologies. We called it a "distance learning experience". The following is the procedure of how to design and publish students' products on the Web.

Design Principles

In fact, design is a process of decision-making (judgement and choice). For one's life (both personal and professional), decision-making skill constantly influences the quality of it. Now students in schools learn scientific knowledge and life skills, preparing to be adults responsible for themselves and for the society in the future. Therefore, we are sure that the design-oriented experience is the tool to teach them how to make decisions.

Teachers and students all agreed on the major decisions of how to design the Web site. These decisions are that the Web site should (1) include the information about students; (2) have a simple style of layout and fewer colors; and (3) have a opening page to introduce the design-oriented projects, within which there are links to other pages of project details. As for the Lego-Logo in motion, we videotaped it, plugged it into computer, and made it a quick-time movie. To create a web site, students learned three basic design principles: Determining

- what it is – to define the site, recognize the information to be put in, plan the scope and sequence, and organize the content into a diagram;
- how it looks – to define the style of the site (always keeping in mind simplicity and consistence), layout of all elements of the Web site, and modify the details;
- and how it works – to decide what multimedia elements to use, design the navigation of the site, recognize functions of each page, and controls of interaction.

Theory Into Practice

After teaching students how to judge and choose what is necessary on the Web site, we worked with them to transfer the design process from paper onto the computer. All students were taught how to create a Web page and how to use a scanner. Students were divided into several groups which are in charge of different tasks of placing all the information on the site. For example, one group was to create Web pages and links; another group was to take pictures of Lego-Logo products and scan them into computer; the other group was to do the research about other Web sites which are related to 3D and Lego-Logo. Students chose the group they wanted according to their own interests and strength. Those who are strong with multimedia technologies were responsible for formatting and testing multimedia elements, such as sound, animation and quick-time movie.

As soon as information layout and navigation links were done, we made sure the files were on the server and ready to be reviewed. All students would examine everything on the site and give feedback to us for edition and revision. Then according to the decisions we had made at the beginning of the procedure, we discussed some issues with students, like color, font and multimedia functions. This was to confirm that we created the Web site for every school, which is user-friendly to accommodate lower level computers. Finally, the schools of these creative students would review the Web site before it was really open to the public.

Interactive Learning Environments

The student created a sundial and used the lighting source in the environment to simulate time. Stemming from this concept the students had discussed: Earth's rotation around the Sun, other planetary movements, seasonal changes, directional settings, shadows made by the Sun, etc. This activity engaged students in interaction with their living environment. Once they realize their capabilities in this artificial environment, they will try and recreate concepts found in their own lives.

Hands-on Process

We incorporated the 3D art process as a tool to reinforce curriculum being taught in other areas. This simulation would: 1. Start with the students learning the 3D environment (x, y, z axis) and the computer program as a tool to create visual media. 2. Incorporate this curriculum to enhance the learning process (introduce, review, reinforce and/or extend material being taught in the regular classroom setting). 3. Publish their finished work on a web site

Teaching/Learning Strategies

The major subject area that fits our 3D renderings is math oriented- parts to whole, patterns, shapes, geometry, ratio, and percentages, perimeter, area and volume. These were items and words used by the students to describe the on going, problem solving activities for most of our sessions. Students were taught by using a step by step procedure to get into the computer program and execute the commands needed to solve the problem.

Step 1: (*a*) How to get into the program; the use of mouse, pull down charts, folders, and double clicking
(*b*) What are the "universe"; "hierarchy"; lighting, camera position, and the Primitive Objects: (Cone, Sphere, Icosahedron, Cylinder, and Cube).
(*c*) How to start a drawing in the universe and save it on a disk.

Step 2: (*a*) Students learned to draw objects in the universe and size them.
(*b*) Students learned how to move around in the universe and find the way back to the preset position.

Step 3: (*a*) Students continued drawings and how to manipulate through the viewing commands to make sure that the objects were -really aligned.
(*b*) Menu Bar = View, Preset Position, and one of these: Top, Bottom, Lift, Right, or Back.
(*c*) The Magnifying tool was introduced to zoom in and out of the settings.

Step 4: (*a*) Students continued drawing items and adding parts.
(*b*) They learned how to use the Numerical Properties chart to resize objects but most of them felt comfortable using visual commands to do this (resizing by clicking on the corners of the object and dragging in the desired directions/ out for larger; in for smaller).
(c) The rotating tools were introduced for turning the objects in space.
(*d*) There were two of them: one to rotate in a flat spin (x and y axis), the other would move all three Directions on the x, y, and z axis. Students' work could be adjusted to fit on the arm of the sundial and lighting adjustments would act as our sun for the shadow needed to make the sundial work.

Step 5: (*a*) Students had been using all the above skills learned from Session 2 through 6.
(*b*) The command of Group and Ungroup was introduced so that students could put many multiples of small objects together and duplicate.

Step 6: (*a*) Students learned how to use color, pattern, and texture to render their objects.
(*b*) Students learned the commands to create a scene with their object inside the Production Frame (View, Prod. Frame) and how to set the lights and camera for the best angle of view for a finished product.
(*c*) Students would adjust the lighting, and decide on the atmosphere to use in the background.

Step 7: Students changed the view and production frame to create a "slide show" of multiple views.

Multimedia & Artificial Intelligence

The students in this project used Lego-logo robotic models as a focus for applying content knowledge toward creative design projects. The students in this project were ninth and tenth grade students with no previous experience with Lego-Logo projects. They were encouraged to follow sample project models to learn the basic construction skills for Lego constructs and computer programming. Later in the projects to control their robots. The students were encouraged to participate in emergent communities to invent their own programmed constructs and to share their design ideas through a web site in order to build a virtual learning community.

Programming

Students used logo command language to create computer-controlled projects. The participants programed vehicles to maneuver along predetermined route and performed specific tasks. Scientific sensors were also used as input devices to control robotic constructs.

Hands-on Construction

Students were given the Lego bricks, blocks, gears and motors and some simple plans for construction. Students needed very little time on sample projects. They began to modify the original plans very quickly. Some groups moved into very creative building while others experimented with different ways to program the function of their creation. Students soon began combining Lego kits to build more and more complex models.

Interaction

Students worked in teams of three to five per project. The teams were flexible in number and selection of project. Some students were more interest in building vehicles while others were more interested in building robotic arms and computer programmed devices using the light, heat, touch, angle sensors. Interaction among students within their own team and with other teams was enhanced through the use of a Web site to

display designs and ask questions of the virtual community concerning problems they have encountered. They also used the Web to find sites with plans from other students and tried to improve on those designs.

Conclusion

The members of this panel represent diverse backgrounds and experience in public school and university level education. The perspectives of the members are from the arts, technology, and the humanities. It is creative design that has been the force behind the energetic enthusiasm of this panel as an emerging community of learners. And it is the power of their own design-based learning experiences with teaching young learners that provides a great depth of knowledge to be shared with the larger community at the Web Conference.

Statistical Information Resource Discovery and Retrieval Using Statistical Metadata

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Abstract: Enhancing the description and representation of information resources provides a very important basis for information discovery and retrieval. Such an approach overcomes the complexity of statistical information. In this paper, we address an approach for statistical information retrieval and discovery using statistical metadata and the search engine *Isite*.

1. Introduction

Handling and analysis of statistical information start with information retrieval and resource discovery. However, such tasks are becoming more and more difficult to accomplish as the Internet and statistical data sources continue to grow in size and complexity. That is because the conventional database management system and techniques for information retrieval cannot be effectively applied in dealing with complex organisation of information such as the mixture of textual, numeric, and even graphic data, etc. and searching complex data objects.

The complexity of statistical information arises from various data types, various data formats, various cross-relationships between data and the diverse distribution of data, of course, also arises from different platforms and information management systems. It is obvious that the effectiveness of the search method depends on how much this complexity is overcome. There are two ways to tackle this complexity: to offer more powerful functionality in the search engine, and to enhance the ability to describe and organize statistical data stores. Clearly, the latter is a straightforward way and relatively simpler to obtain compared to the former. This is our motivation to describe and organize statistical data in a distributed environment by means of statistical metadata and SGML (Standard Generalized Markup Language).

In this paper, statistical metadata is used to refer to the characteristics of statistical data. It is divided into the two categories of declaring metadata and processing metadata. The former is used to describe statistical information for the purpose of locating, accessing and organising the statistical data residing in diverse locations. In particular, we concentrate on using statistical metadata to describe the compound textual documents containing numeric tables, graphical figures, and even more links connecting remote data objects. The typical approach adopted for statistical metadata involves the selecting of representations of concepts that characterize the structure, context, and content of statistical information; the generating of metadata structure based on the statistical domain, a minimal metadata set, called statistical metadata structure. With respect to the processing metadata, it involves the handling and analysis of statistical data incorporating statistical macrodata and microdata. At issue here is the first category, declaring metadata.

There is a natural correspondence between statistical metadata structure and SGML's DTD (Document Type Definition). The DTD provides a good facility for the specification of metadata and for the description documents using the metadata. SGML focuses on the document description – hence its content – and not on the display of the document [Bryan 1997]. The structure of an SGML-coded document is formally defined in a set of markup declarations that form a DTD. These markup declarations describe a set of markup instructions, known as tags, which can be used to identify the start or the end of logically constituted parts in the coded documents, and the links with external information resources. In this work, statistical metadata are directly mapped as tags in the DTD.

Retrieving a collection of SGML-coded statistical documents using statistical metadata distinguishes from existing search methods such as Lycos, Alta Vista, InfoSeek, etc. An underlying difference is that in the existing search engine methods, META tag is designed for constructing an HTML header to declare keywords and a description such as AUTHOR, DESCRIPTION, and KEYWORDS [Int_inf], rather than for describing and representing the content, structure and external links of a document. The benefits of supporting full document search using metadata are shown in the following section.

2. A Statistical Metadata Framework

A single document is not able to contain complex data objects. However, a statistical container is capable of containing these data objects, and the relevant descriptors of these objects, statistical metadata. That is a proposed statistical metadata framework. In contrast to Dublin Core [Weibel and Iannella 1997]

which describes essential features of electronic documents and document-like objects, the statistical metadata is focused on describing the content of textual documents and connections with external complex objects, thus imposing a structure on the unstructured document and establishing links to the external objects that remain the original formats. In fact, this framework is a wrapper of content of a document and URI (Uniform Resource Identifier) of the objects embedded in a document.

The combination of statistical metadata and SGML leads to the creation of a DTD associated with the statistical domain, which may be viewed as a standardized format with an SGML syntax. This provides a good facility for organizing statistical data, because all of statistical data objects, including textual documents, numeric tables, graphic figures, and cross-reference links, etc. are described, represented and organised in the same DTD environment. Therefore, the consistency of describing data objects and their relationships is achieved. Following this scheme, a comprehensive document is partitioned into a collection of small and manageable segments according to the DTD, and for each segment, there is a tag – statistical metadata describing or representing it semantically. As a result, an unstructured document can be transformed into a structured document with statistical metadata structure. The advantages thus obtained are: to provide a linking mechanism between the complex data objects; to overcome the complexity of statistical data to some degree; to facilitate the development of handling and analysis of statistical data; to make effective use of existing search engine tools; and to cross different platforms.

To illustrate the specification of the statistical information using SGML, we consider a flat structure model of the OECD "Economic Indicators" [OECD] tagged by the statistical metadata. We have:

```
<Indicator>
        <Title>Main Economic Indicators></Title>
        <National Accounts>
                :
        </National Accounts>
                :

</Indicators>
```

A formal specification corresponding to the above structure can be defined in the following DTD. The DTD is expressed as a set of declarative statements using a simple SGML syntax. The following declaration is an example of a formal SGML specification of the above structure:

```
<!- - DTD for Main Economic Indicators - - >

<!ELEMENT indictor                  - -     (title, naccount, production,... ,
                                            bpayment?)>
<!ELEMENT  title                    - -     (#PCDATA)>
<! - - National Accounts- - >
<!ELEMENT  naccount                 - -     (line+)>
<!ELEMENT  line                     o o     (#PCDATA)>
          :
```

A complex structure ensures when the sections and subsections in the Economic Indicators are properly nested, implying that a hierarchical structure is associated with this document. This structure can represent cross-references or external complex objects though reference linkages.

3. Conclusion

We implemented a prototype for retrieving SGML-coded statistical documents using the *Isite* search engine, which is developed by the Center for Networked Information Discovery and Retrieval (CNIDR) [Gamiel 1996]. Its search methods are based on free-text and fields demarcated by tags. One important characteristic of the field search method in the prototype is that it can be used to retrieve and discover relevant and external data objects through links. The results demonstrate this approach can not only be served as a remedy to the deficiency in text query and in accommodating complex data objects of the statistical database, but also provide an extension to the conventional bibliographic-like search method as well. Meanwhile, the domain-specific metadata standard offers a solution to overcoming the complexity of statistical data objects.

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INTERACTIVE EXERCISES AND AUTHORING PROGRAMS FOR LANGUAGE LEARNING ON THE WEB

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We demonstrate original Web-based interactive materials for language learning and the authoring tools for their creation. These programs, which incorporate text, audio and video, run on the Internet or an Intranet, or on a stand-alone machine without an Internet connection.

The programs present examples of language from authentic contexts, evaluate a user's input and provide feedback automatically, or, in the case of a free practice exercise, the learner's input is forwarded to a teacher via e-mail.

We have developed a variety of tasks to develop the learner's reading, writing and listening skills with exercises designed to raise awareness of the structural and lexical systems of the target language. The tasks aim to engage learners cognitively by requiring them to analyze, compose, order, edit, and reconstruct text: learners select or type in appropriate words or phrases to complete a text, match elements ranging from morphemes to sentences and paragraphs, compose sentences from 'chunks' of text, or edit a text identifying words which have been omitted, added or spelled incorrectly.
Some exercises incorporate video clips: the learner listens and reconstructs the text, which has been segmented into tone units.

The user may set an exercise to 'learn mode' or 'test mode': students may try an exercise with the words displayed in a list before testing themselves by entering their own text. Few exercises require the learner to simply click on the correct answer to a question.

AUTHORING PROGRAMS

The learner or teacher may create their own interactive exercises for a given language using any simple text editor or word processor, or by using the on-line authoring programs. No knowledge of HTML or programming is required.

We have designed the authoring programs to enable the user to produce a wide variety of exercise formats, and to facilitate the creation of exercises to focus on syntax, collocation and other lexical phrases, hyponymy, meronymy, etc.
The programs are on-line at http://www.point2.co.uk/lnet/
http://www.language-net.co.uk (From October 1998)

Back Pain School on the Web: Clinical, Technological and Pedagogical Challenges

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Presentation of a pedagogical and clinical Web site concerning chronic low back pain (http://uriic.uqat.uquebec.ca/). This important health problem is multidimensional and an educational approach is required to bring relief to those who suffer.

The Interactional Back School (L'École interactionnelle du dos), developed at the University of Québec in Abitibi-Témiscamingue in collaboration with the University of Bordeaux, is a structured, therapeutic program designed to teach sufferers to treat their own lower back pain. Involving an interdisciplinary approach, the method includes physical and mental preparation, attitude and behavior changes, and cognitive learning of anatomic and ergonomics concepts.

The Web site is dedicated to two types of users, patients and practitioners, and include these sections: *Interactive documentation for the patients, Virtual clinic, Credited courses for training clinicians*.

On the Web site of the Interactional Back School, hundreds of pages have already been organized but many challenges remain : *Clinical, Technological and Pedagogical challenges.*

Form Follows Function: Using an Intranet to Mirror Library Staff Reorganization

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Abstract: In 1996, the Medical University of South Carolina Library created Webster, an intranet comprised of various toolkits and divisional resources. This paper describes the 1997 development of a new toolkit designed to help reorganize several public services and education departments into one division, and to foster collaborative communication.

1. Introduction

In the developing Internet, much attention has been directed towards the establishment and maintenance of "virtual communities" formed by geographically distant individuals and groups with similar or tangential interests. For the past year, the Medical University of South Carolina Library has used an existing intranet as a virtual launching pad for a new work unit. The Department of Library Science & Informatics manages and provides access to resources, systems, facilities and personnel that support the educational, research and clinical interests of the university. In the recent past, ownership of library resources defined access. Present and emerging digital technologies have redefined access, regardless of physical location. Technology has shifted the emphasis towards user-centered services [Harris et al. 1996] and away from place-centered collections [Riggs 1997]. The evolving body of biomedical knowledge requires libraries to establish lifelong relationships with users from school days to clinical practice to retirement years, and to extend access to near and distant sites.

2. Approach

In August 1997, several Library departments were reorganized to form the Public Services & Education (PS&E) division. Spread out over 48,000 square feet of assigned space on different floors of the same building, these departments were managed by relatively independent managers, and consequently developed different approaches to problem solving, program development and service provision. We used intranet technology to establish a group identity, maintain a divisional focus, emphasize collaboration, provide content needed to function in new roles, reduce reliance on paper files, and normalize expertise throughout.

This new set of neighbors needed specialized information and original content. A new toolkit was organized within Webster, the intranet framework designed and developed by Systems staff. Intended for all Library

faculty/staff and originally showcased in January 1996, Webster functions as a dynamic snapshot of a modern day academic health sciences library.

The PS&E toolkit subsumed separately designed and maintained toolkits for circulation, reference and learning resources. The care and feeding of this resource is intended to mirror, parallel and ease the reorganization of several departments into a single division, and to provide a forum in which to discuss and discover.

As described in an article discussing criteria for building communities [Kim 1998], the project required a purpose. The new toolkit's purpose was predicated by the division reorganization itself and the need to redefine work routines. Staff members were asked about the kinds of resources needed to improve work flow and customer service. Content was customized to reflect present and future needs, and organized by function rather than department.

As did Allsport Photography [Mullich 1997], we encountered concerns that the project might destabilize the network, consume remaining server space, and/or reduce available memory on staff workstations. Like our commercial counterparts [Sliwa 1998], we decided that collaborating electronically, sharing information, and exchanging ideas over an intranet would improve customer service.

Recognizing the human tendency to limit or guard access to data, future plans include the selective use of cookies to customize content, exploration of useful agent technologies and utilization of security technologies such as digital certificates [Sliwa 1998].

3. Concluding Remarks

The toolkit's sustainability and viability depend on buy-in, ownership and the ability of each employee to contribute ideas and resources [Callaway 1998], regardless of their individual Web publishing skill level. An important step towards realizing an open intranet [Gibson 1997], encouraging division-wide contributions and shifting the maintenance burden away from the original developers was the March 1998 introduction of do-it-yourself file uploading. It is not necessary to seek administrative approval or ask someone else to upload the files. The next steps include providing easy-to-use templates and allowing WYSIWYG real-time updating.

The human side of developing an intranet cannot be underestimated. Prior to the establishment of the division, employees tended to seek permission, and convene large group meetings in efforts to reach consensus, resulting in long project timelines and uncertain completion dates. This project encouraged expansion into new areas of interest, developing new expertise and taking decisive action. The new toolkit is one way to keep people informed and acknowledge their contributions, important considerations when phasing and implementing organizational change. Administrative support for this project fostered the desired changes in critical thinking and problem solving skills. Prior to the reorganization, each department functioned as an autonomous and somewhat isolated unit. The process of developing the new toolkit reflects a new focus on interdepartmental collaboration. This experience helped us reduce production cycles, take chances, trust co-workers and work in small, productive teams. As the division evolves, the toolkit will mirror and reflect a dynamic and collaborative enterprise.

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Using Internet Technology to Assist Parental Involvement in Education

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As the fastest growing educational software publisher, Virtual Knowledge has helped hundreds of thousands of parents assist their children with their Children Skills Tests. With the great progress that has been made in Internet technologies, and as on-line communications have become more accepted, the Company has developed new solutions for the World Wide Web.

Virtual Knowledge realized that the country is experiencing a back-to-basic skills trend in education, focusing attention on assessing and tracking what students know and can do. Parents want to become more involved with their children's education, yet they are often unsure of their children's relative level of academic development in key subject areas. When it comes to finding appropriate tools to help their children, parents frequently do not know which educational products to purchase for their children's particular needs. In short, parents are extremely eager to help their children, and need help to do so. Virtual Knowledge developed SmarterKids.com to addresses this need.

Virtual Knowledge set out to create SmarterKids.com as the most authoritative resource for children's education at home. Realizing that this is quite a formidable task, the Company began to map out how to take the concept to reality.

There would be a variety of challenges ahead. Could the Company's current Web server support the volume of hits that would come? What software would be used to manage the countless number of educational products, learning profiles, and users – not to mention the order processing, fulfillment, and inventory operations that the site would need to perform?

SmarterKids.com is very different from a traditional retail or catalog-like experience for the consumer. It is, rather, a personalized experience built around authoritative and credible assessment testing, and high quality educational products. This requires a capability for parents to upload test results, and then for the site to interpret these results in a way that delivers meaningful results to parents.

David Blohm will share with the conference attendees the strategies and techniques used to bring SmarterKids.com to life. Mr. Blohm will detail the development from the initial concept to the creation of the SmartPicks engine. This fascinating and educational presentation delves into the ideas and technologies that created the first ever service for parents to make informed recommendations by linking children's assessment results to the directly to skill areas of the items that are recommended.

David Blohm is the President & CEO of Virtual Knowledge, Inc., a publisher of multimedia children's testing software. The Company's flagship products, marketed as the Sylvan Children's Skills Tests, assist parents in measuring and tracking their children's overall scholastic development, and help parents develop strategies for maximizing their children's potential.

Prior to joining Virtual Knowledge, Mr. Blohm co-founded MathSoft, Inc., in 1985. MathSoft develops and markets Mathcad, a mathematical calculation software package. From 1985 to 1994 Mr. Blohm served as president and chief executive officer of MathSoft. During his tenure at MathSoft, Mr. Blohm grew the company to $30 million in sales and led it to its initial public offering in 1993. Prior to 1985, Mr. Blohm was chief financial officer of Higher Order Software, a developer of computer-aided software engineering tools.

Mr. Blohm serves on several committees which focus on expanding the use of technology in the educational community. Currently, Mr. Blohm is chairman of the Massachusetts Software Council and chairman of the Council's Education Task Force. In this capacity he oversaw the development of The

Switched-On Classroom, a widely-used guide for educators who are integrating computers into the classroom. He also guided the committee in establishing the Massachusetts Tech Corps, a program which partners volunteers from the high-technology industry with educational institutions as they implement high-technology programs. A U.S. Tech Corps, endorsed by President Clinton, has been established based on the Massachusetts model. Mr. Blohm is also a member of the Corporate Board of the Massachusetts Net Day initiative, is an overseer at the Boston Museum of Science where he co-chaired the Museum's first Educational Software Fair and serves on the Corporate Executive Council of WGBH-TV public television.

A Web based Virtual College

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Abstract: The need for tele-education is rapidly growing. This paper describes a tele-educational environment and reports on experiences obtained during international trials. The tele-educational environment is build around the metaphor of a college. The virtual college offers the opportunity for students to participate in desktop tele-education from their homes or offices. The environment is based on Internet technology and the user interface is a common Web browser. Students navigate through the virtual college by entering classrooms, group rooms, studies, and teacher offices. During breaks students can visit a virtual tea room.

Keywords: Group work, lectures, self study, tele-education, virtual college.

1. The Virtual College

Tele-education will play an increasingly important role in the future. The need for education is rapidly growing due to the rapid changes in society. New technology is introduced with an astonishing speed never seen before. This makes vocational education at least as important as basic school education. Education will be a life long activity, and social and economic welfare will be linked with education. This is true for both individuals and countries.

The propagation of the Internet now makes tele-education based on Internet technology possible in most places. Hereby is introduced a means to make life long education achievable in an efficient way. In particular the Internet supports "desktop tele-education". This concept means that individual students participate in tele-educational courses from their offices or homes using a desktop computer online connected to a course provider. What is needed is a multimedia PC, a headset and an Internet connection.

The tele-educational environment described in this paper is developed with "desktop tele-education" in mind.

It is very important that a tele-educational environment is easy to use. The environment itself should constitute a minimum learning threshold for the students. This goal has been achieved in two ways. First of all, the main user interface is a common web-browser. This means that everybody familiar with the Internet will be familiar with the interface of the tele-educational environment. Secondly, the environment is build around the metaphor of a college. This means that the user interface looks like a real college with different rooms for different purposes. The students will find a classroom for lectures, a group-room for group-work, a study for self-study work, a teacher's office, and a tea-room

for social interaction. The different rooms make it easy and intuitive to navigate in the educational environment.

The virtual college applies different modes of teaching and learning. This includes synchronous modes like on-line lectures and group exercises as well as asynchronous modes like interactive self-study, participation in threaded billboard conferences and sharing of documents.

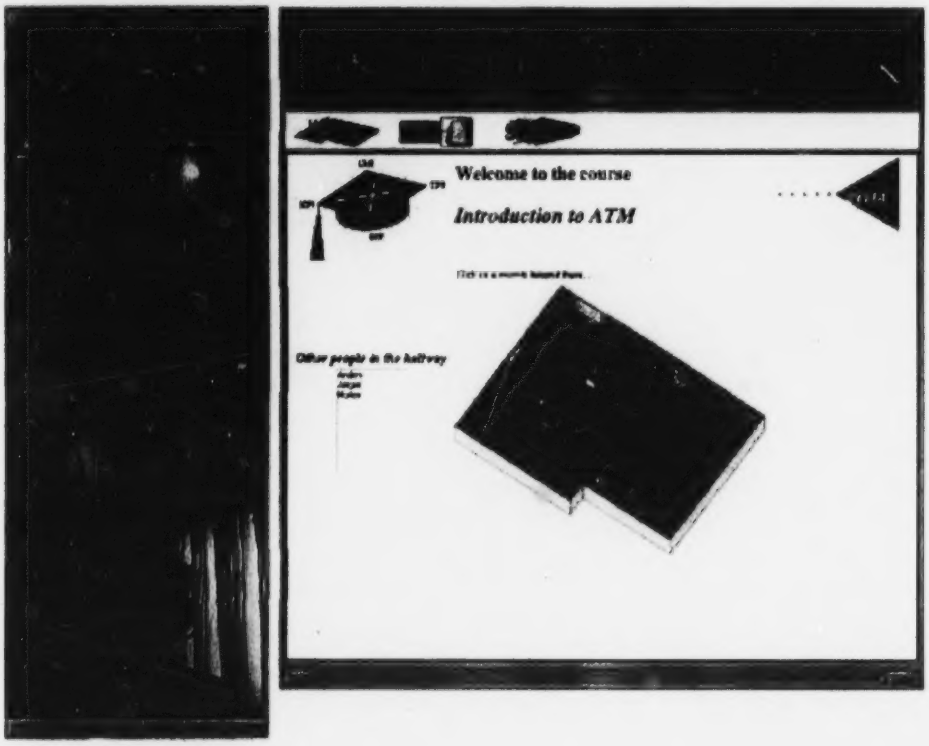

Figure 1 - The user interface to the virtual college

A challenge in designing the tele-educational environment has been to integrate these modes of education and to combine them with the metaphor of the college. This integration has resulted in a tele-educational environment, which is intuitive and easy to understand for both students and teachers.

The virtual college is based on Internet technology. The present implementation of the virtual college uses the Netscape Web-browser, extended with loosely integrated audio and video tools. It is an obvious advantage to base the virtual college on this well-known industry standard, which makes it immediately accessible to everybody familiar with Web-browsing.

The virtual college is highly scalable. This means that it can be adjusted to the actual needs and existing infrastructure, in particular to the available communication bandwidth. Although it was developed with broadband communication in mind, the virtual college can be scaled down to an Internet environment by carefully restricting the usage of audio and video conferencing facilities. A more detailed description of the tele-educational system in a broadband telecommunication environment can be found in [1].

BEST COPY AVAILABLE

2. The Rooms

The virtual college looks like the plan of a "real" college. There are different rooms each serving a specific purpose. The design of the virtual college is modular. This makes it easy to furnish the rooms according to their intended usage. The furniture consist in tools like audio and video conferencing, a shared white board, a slide presentation tool, etc.

In addition a first version of a floor control system has been included in the environment. It enables the teacher to control who is able to speak thereby making the communication more disciplined. Students can add themselves to a list of speakers, e.g. for making questions. This list is part of the floor control system.

The classroom is the place for on-line lectures and presentations. This implies that students must be "present" in the class room during lectures. The class room can be furnished with an audio tool and depending on communication facilities also with video conferencing facilities. There will be a whiteboard to allow the teacher to write and draw, and a slide presenter for the teacher to show educational material. It is also possible to show any page from the Web on this slide projector.

The office is available for the teacher and is furnished with course administration tools. For example this could be tools for making new self-study material available for students during a course. The office can also be used for private consultation for students. In this case audio and video conferencing tools could naturally be part of the room as well as a shared note pad.

The study is the student's office. Here the student will find self-study material, exercises, slides from previous lectures, supplementary material (like in a library) and links to other sites on the Web. The self-study material is made highly interactive with animations, self tests, indexes and bookmarks. This room is for the asynchronous mode of education and the student can work here at any time. There is no interaction with teachers and other students in the study room.

The group rooms are furnished for small groups of students to meet and work together on exercises and to do group works. This requires audio and preferably also video conferencing facilities, shared cooperative tools like a note pad and whiteboard, and of course the relevant group exercise.

The tea room is supposed to be used for informal chat and social contact with fellow students during breaks. The tea room is furnished with a number of tables where students can sit and have a virtual "cup of tea". Each table has its own audio and video conferencing facility.

The information poster in the hallway gives all the administrative information about the course. This includes timetables and descriptions of lectures, group work and self study modules. Descriptions and pictures of all teachers and students participating in the course can also be found here.

The billboard contains different threaded conferences, each related to a particular topic. These conferences are related to the topic of the course and students are expected to make contributions as part of the education. The teacher will regularly monitor the billboard.

3. The tools

Each of the room in the virtual college is furnished with different tools according to the needs for a particular room.

- The shared whiteboard has the basic functionality for drawing and writing. It can be used with a background image. This is useful for group exercises where students discuss a diagram and during lectures where the teacher can draw on a slide.

- The shared notepad is related to the whiteboard. It is used for shared working on small text documents. The notepad has the basic text editing functionality needed for collaborative work on text, however the functionality is limited compared with professional text editors.

- The slide presentation tools primarily used in the class room. It allows the teacher to show slides and students to view these slides. The whiteboard can be included on slides. This allows the teacher to add notes on slides during presentations.

- The shared bullet tool is closely related to the slide presentation tool. The teacher can use this facility to put the attention of the students to specific points on a slide.

- The audio and video control starts and stops conferences. It includes functionality for muting and un-muting audio and video. This control is partly integrated in the floor control system.

- The message tool is used for sending and receiving small messages between persons present in the virtual college.

- The other users is a tool that shows who is also present in a room. By clicking the name of a person the personal data of that person will appear.

The virtual college and accompanying tools are implemented in Java, which makes it platform independent. The rapid development of Internet technology has made it a challenge to comply with the latest releases of Java and Web-browsers.

4. The Trials

The virtual college has been used in different trials during the last year and further trials are planned in the near future. The first trials were run in a local area network environment in order easily to monitor and control the students and the technology. Two major pan-European trials were conducted recently. The trials included about 40 students and 2 teachers located at 6 sites in four countries: Denmark, England, Germany and Ireland. The JAMES (Joint ATM Experiment on European Services) broadband network connected the sites during the experiments.

The topic of the course was "An Introduction to ATM". The students were partly recruited from industry and partly from academia. They were not required to have any specific qualifications related to the topic of the course. Each course was run over 4 days and consisted of 4 class room lectures, 3 self-study modules with exercises, 3 group exercises, and one class room discussion.

This very tight schedule was made for practical reasons such as network availability. To some extent it hampered the experiments. In a real application of the system the course should have run over at least two to three weeks and less activity each day.

5. The Experiences

The trials have been carefully monitored and evaluated. After each trial parts of the system was updated based on experiences gained. The main conclusions were that the users liked the virtual college. They found the college metaphor easy to understand. They had no problems navigating through the virtual college. Another result was that the two modes of teaching complemented each other very well.

Generally on-line teaching and group work seem to be a motivating way of learning. But it also appeared to be very demanding for the students to follow a course in this environment. This is because the student's attention is concentrated on the computer screen and the audio input received. Students simply get tired and loose attention. For this reason lectures must be relatively short, not more than half an hour. Also the total course activity each day must be limited.

Students are positive about the class room form of teaching. However, all students are not equally prepared to ask questions. Some students never ask questions in this environment, others quickly become heavily engaged in discussions and trying out the boundaries of the media. Generally students find it easier to ask questions here than in an auditorium. On the other hand it is more difficult than in a classroom. In other words, the "communication distance" between student and teacher is perceived smaller than in an auditorium but still bigger than in a "real" classroom.

Experiences from the group exercises showed that students might have difficulties in initiating and performing efficient group work. Some students seemed alienated towards the environment and made no attempts to get engaged in the group work. Other students worked very well in this environment, so no definitive conclusion could be made.

The billboards are easy to accept and to use. However, it is necessary to engage the students to really using these facilities, e.g. by giving them specific assignments. During the trial some very interesting discussions took place, but only few students participated. This might be due to the tight schedule of the course.

The teachers require some new skills in the virtual college. For examples must the teacher be able to coach the students into using the media. Also in case of technical problems the teacher must be able to help.

It is well known that it is very time consuming and hence very expensive to develop the self-study material. The experience is that with high quality material the students are satisfied and the learning effect is good. The combination of self-study material and online lectures and group exercises seems to be a cost-effective way to conduct tele-education.

6. Conclusion

The feedback from experimenting with the virtual college in an international setting has been encouraging. The concept was well accepted by the students. They quickly became familiar with the environment, the learning effect was good and they appreciated the attempts to introduce some social ingredients into this virtual environment.

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The Performing Arts Data Service

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Abstract: The Performing Arts Data Service (PADS), funded by the Joint Information Systems Committee (JISC) and based at the University of Glasgow, aims to support research and teaching in UK Higher Education by collecting and promoting the use of digital data relating to the performing arts: music, film, broadcast arts, theatre and dance. The PADS is one of 5 service providers of the Arts and Humanities Data Service (AHDS) which will provide a single gateway for arts and humanities scholars wishing to search for datasets across various discipline areas. Data is indexed with Dublin Core metadata, will interoperate with other databases within the AHDS and beyond, and will be available via the Web.

1. Introduction and Background

The Performing Arts Data Service (PADS) is one of a syndicate of five Service Providers appointed by the Arts and Humanities Data Service (AHDS)[1], funded by the Joint Information Systems Committee (JISC)[2] of the UK's Higher Education Funding Councils, and is based at the University of Glasgow. The AHDS's mission is to co-ordinate access to, and facilitate the creation and use of, electronic resources in the arts and humanities by offering a range of services. It will encourage scholarly use of its collections and make information about them available through an on-line catalogue.

The AHDS provides a single gateway for arts and humanities scholars wishing to search for datasets across various discipline areas. Other service providers include: the History Data Service (HDS), The Archaeology Data Service (ADS), the Oxford Text Archive (OTA) and the Visual Arts Data Service (VADS) [3]. The service providers' databases interoperate with other databases within the AHDS and beyond via Z39.50[4], and searching will be available via the Web. In order to achieve meaningful search results, data from all the service providers is indexed with Dublin Core metadata.

The Performing Arts Data Service's role within this framework is to support research and teaching in UK Higher Education by collecting and promoting the use of digital data relating to the performing arts: music, film, broadcast arts, theatre and dance. The PADS differs from the other service providers in that it has a particular concern with data consisting of and representing time-based media. The results of two recent projects have had a major influence on the system of the PADS as it stands today. The (Scottish Higher Education Funding Council funded) **NetMuse** Project[5] was a project developing web-based music courseware for delivery over the ATM based Scottish Metropolitan Area Networks (MAN's). This included development of a Java based audio player [Malloch and Pflicke, 1997] for streaming full CD quality music, further developed as part of the **SMaTBaM** project [Boehm 1997] (Serving Massive Time Based Media[6]). The SMaTBaM project researched storing, retrieval and delivery of time-based media and was designed specifically to benefit the work of the PADS whose remit does not extend to conducting research.

The SMaTBaM project researched and set up a prototype of a system which had to be suitable for the PADS, including the means of delivery of time based data as well as the storage and retrieval issues. This prototype has been scaled up and forms the basis of the PADS system which consists of two Silicon Graphics (SGI) Origin 200

servers: one is a media server streaming audio and video using SGI MediaBase software; the other runs an object-orientated database with a web-gateway (Hyperwave Information Server) which stores both the non-time-based data and the metadata of the material on the media server. This solution combines the demanding performance of a media server with the advanced database features required for modelling and handling big collections of data. Addiotional gateways have been set up to secondary remote Hyperwave servers via HGI-CSP, realtional database management systems via Netdynamics and library databases and catalogues via a newly implemented Hyperwave-Z39.50 gateway.

Thus the user, although accessing information from different locations, different platforms and different kinds of databases sees one sort of interface, i.e. a browsable webpages guiding him through the information space via navigational aids such as discipline specific and discipline independant searching templates, knowledge domain related, hierarchical browsing hierarchies, depiction of relationships between resources via metadata and other hyperlinks.

The PADS has recently been involved in a major project to provide a digital catalogue records for the Scottish Music Information Centre (SMIC)'s unique collection of scores, manuscripts and recordings, with funding from the Scottish Cultural Resource Access Network (SCRAN). The project "Five Centuries of Scottish Music" aims to digitize 1000 items and metadata of manuskripts, scores, composers' bibliographies, concert programmes and recordings of ten representative scottish composers taken from the last 5 centuries and adding an additional glossary explaining musicological relevant terms mentioned in these records. This project is near its final stage and the collectiom is planned to be accesable in the near future.

This paper will cover three principle areas:

- the general information systems requirements for serving time-based media over the web;
- the PADS system architecture
- a report on the experiences gained in the first major effort to make a collection of 1000 digital recources available: the SCRAN/SMIC/PADS project.

2. Information Systems Requirements for Performing Arts data on the Web

In a time where the internet becomes the platform, the browsers become the operating system, and applications become services a digital library project set in the perfroming arts has to define new methods of storing and distributing time-based data to be able to serve quality and quantity information across wide area networks. It also requires solutions of the more philosphical areas of research into how interfaces have to be set up and how information should be represented in order for users to handle vast amounts of data as intuitively and as user friendly as possible. In order to cope with the information increase and user capacity expected information management services will always have to deal with the "three I's": Information Structure, Information Representation and Information Access.

2.1. Nature of the data in the performing arts

A collection dealing with Performing Arts related data consists of both secondary resources i.e. materials about the performing arts, moving image and sound-based media, and primary resources, i.e. the digitised multimedia objects themselves. As data compression and transmission technologies develop in the future, it is the service's aim to facilitate the real-time access of video clips, sound files, movies, musical performances and multimedia productions - both primary and secondary resources.

It is desirable that a collection is able to be expanded by collections of other service providers holding resources in the same field but at the same time maintaining a "one-stop shop" in accessing time-based media resources. This distributed resource environment allows the option of other collection holders keep and maintain their collection physically in their own repository, while access is handled by a central access point.[7]

A performing arts resource collection encompasses a wide range of different disciplines, starting with the disciplines of music and film and stretching further toward dance, theatre and the broadcasting arts.[8] The

resources as a whole can be characterised as a) being made out of different types of data, b) containing differing complexities of data, c) possessing different relationships, and d) being time-based in their nature.

2.1.1 Different types of data

As with all multimedia related systems, all the "usual" data types are involved from sound, video, text, image and binaries. Storing them in a certain way provides us with a more complex entity of data types: html, sgml, mpeg, wav, gif, jpeg, java, etc. It is certain that these data formats will evolve further in number and content. The use of different formats in a system should therefore be a means but not a solution. In other words, to minimise the danger of storing data in standards that might not be supported in the future, much thought should go into separating the content of a resource from its presentations. To be able to store a resource in the highest quality possible, combined with the ability to convert it into formats suitable for a certain purpose, or added formats in the future, is to provide an open and flexible system with maximum compatibility in the long term[9]

2.1.2 Differing complexity of data

Whereas video and images might be stored largely as single binary data-objects, music, theatre and the broadcasting arts could involve the storing and accessing of highly structured data, presenting complex objects or 'composite objects'.[10] In some cases, it might be hard to distinguish which is the real, the original resource, and which is a composite part of it. If one accepts the fact that the content of a resource might be of complex or composite nature, then the step towards devising a way to store it as such is not far. Technologies are needed that offer the ability to depict, represent, access, store and manipulate complex structures in their complex "Gestalt". A broadcasting feature, as one resource, might encompass video data, sound data, and text data and still be one work of art.

We should accept the fact that our future data might not remain in its binary form and much of our present resources have never been in the "Gestalt" of one entity. Java Applets, Webobjects and other distributed object environments are already being used by artists to create works made out of many components and having many facades. Also the existing resources, which have been traditionally stored as metadata in catalogues, while their real content is being stored as artefacts in shelves, cassettes, or discs, are often not just one entity. In trying to devise resource systems of the next decade, it would be illogical to diminish the resources and their "real-life" manifestation by disregarding their composite character.

It was clear for achieving the above requirements, normal library catalogues and conventional relational database management systems would not be sufficient. Object-oriented or at least object-based information system technologies would have to be imployed.

2.1.3 Different relationships

Assuming that we have objects stored in a persistent way, the access and search results are influenced by the context these objects are in. The mapping of content and context into a digital world means defining and storing different kinds of relationships between objects. Examples for generic implementations and standard definitions can be found in OMG's Object Request Brokers and their Relationship Service Specification for distributed objects [OMG CORBA-Relation 1997] or in the Knowledge Interchange Format of the Laboratory for Advanced Information Technology [Finin and Labrou 1997]. Relationships can be of numerous variety. For example, five basic relationships widely used in information systems are:

- **Inclusion* - one object is included in another object (e.g. a file in a folder, a certain sound used in a composition, a note in a bar)
- **Inheritance* - one object inherits the characteristics of another object (e.g. all service provider users have read rights, these might be inherited down towards the developers of collections, who also have write rights; or, as a third example, all sounds stored at high quality inherit the characteristic of being served out over ATM network only).
- **Association* - one object is associated with another object (e.g. Mendelssohn's composition *Fingals Cave* is associated with the geographical rock formation of Staffa. Another example would be that two pages can be associated with each other in form of a sequence. One page should follow the other in a certain context as for instance a book, course, slide show, score etc.).

- **Attributes* - an object contains certain attributes, or certain characteristics which describe its state of being or its internal structure (e.g. all objects in the PADS archive have the attribute DublinCore, where the DublinCore object itself has 15 further attributes defining the elements of the Dublin Core, see 2.2 Metadata).
- **Web Links* - Web-links can be thought of being a realisation of a certain kind of association in a web environment. The publication of these resources involves the presenting of one resource via different types of other resources or one resource related to others. For instance, a computer-music piece may exist as a sound file, presenting the first recorded performance, as well as archived as the code of the computer program itself and the secondary information associated with this resource.

Whereas relationships belonging to the categories of inclusion and inheritance are implemented "hard-core" into the PADS system, attributes can be thought of being the metadata of the objects. Unlike normal library system in which only metadata about objects is stored, which are not held digitally or stored seperately, in the PADS system attributes belong directly to the objects described by them. In order to facilitate an interdisciplinary approach of resource discovery, the PADS within the greater context of the AHDS searched for a standard way of describing resources across different disciplines, across different types of resources and across the different service providers.

During 1997, the PADS engaged in various activities to investigate and debate how best to facilitate resource discovery in an on-line setting. Specifically, the PADS looked at the metadata standard known as the Dublin Core[11] and how it could be applied as a tool to describe the time-based (sound and image) data resources that are the special responsibility of the PADS. The PADS work [PADS Metadata 1997], which formed part of a series of activities in all the arts and humanities discipline areas represented by the AHDS, was conducted under the auspices of the AHDS and the UK Office for Library and Information Networking[12] with funding from JISC. The aim of the series was to explore how different subject domains both describe and search for electronically held information and to evaluate the usefulness of the Dublin Core as common set of concepts shared across disciplines that may be used in the construction of the AHDS's integrated catalogue.

One of the attractions of the Dublin Core metadata set is its simplicity - the Dublin Core was originally intended to be used by non-specialist authors to describe World Wide Web documents. Although the AHDS workshop series[13] and other initiatives from the library and information community have proposed some fairly complex and lengthy qualifiers, and the AHDS has proposed amendments to some of the definitions, the Dublin Core consists of 15 basic elements:

1.	Title	6.	Contributor	11.	Source
2.	Creator	7.	Date	12.	Language
3.	Subject	8.	Type	13.	Relation
4.	Description	9.	Format	14.	Coverage
5.	Publisher	10.	Identifier	15.	Rights

The PADS held two workshops in April-May 1997, inviting participants with a cross-section of expertise and interest in moving image and sound resources from both service provider communities (libraries and archives) and user communities (UK academics in performing arts disciplines). The groups examined the potential use of the Dublin Core for describing time-based resources, tested it against a variety of examples and critically reviewed its application. The findings from the workshops, which have been bourne out by subsequent pilot applications to PADS data, were that the Dublin Core could function adequately, but there were some reservations and concerns over certain of its elements. [14] The experience gained was used to develope and implement a Dublin Core Metadata set with a data entry scheme, including additional subelements, which would work for performing arts data resources in general and for the SCRAN/SMIC/PADS project "Five Centuries of Scottish Music" specifically.

2.1.4 Time-Based Data

The common denominator of many prospective resources of the PADS service has the characteristic of being time-based. Storing and accessing time-based media requires special attention in storage and delivery of the objects. Solutions are needed to store information in its inherent complex form on the server side, to transmit these information packages in real-time with high-quality over a wide-area network, and to provide a user

interface able to access and use the resources intelligently. For a high-quality service four types of time-based material, all requiring real-time access, can be identified:

- *large binary data objects:* such as sound or video - streaming binary data combined with using a guaranteed bandwidth to ensure no glitches or breaks. Requires:
    - high performance networks providing high bandwidth and guaranteed quality of service;
    - client-server software tools to provide the streaming;
    - high-performance media servers, and high-end client workstations.
- *subsets of large binary data objects:* playing just a part of a sound or video
- *two or more parallel large binary objects:* such as synchronisation of multiple audio streams, requires Intra-stream and Inter-stream synchronisation to maintain the temporal relationship between multiple streams [Robertson 1998 and Robertson 1998] E.g. 'lip sync' in film and tv, where sound and vision tracks are often recorded on different media.
- *complex objects:* such as MAX music scores, more complex Java applications, or sound-sound combinations require a fast and time-coordinated access of all the composite parts of an object: the synchronisation of multiple, periodic, logically independent streams of arbitrary type.[see Flinn 1995]

In the first two instances, high-performance media servers designed specially for serving time-based media offer many solutions for streaming large amounts of data. Automatic recognition of bandwidth and consequential choice of compression and delivery means ensures that users have the best quality availble to them. More difficult are the last two instances. First results to synchronize separate streams on ATM networks have been achieved trhough the work of George Robertson at the University of Glasgow [Robertson 1997] and are planned to be integrated into the PADS system. Several upcoming standards such as MPEG7 will hopefully further this research and evelopment.

3. The PADS system

3. 1. PADS System Infrastructure

A goal of the PADS service is to provide interoperability with other collection holders by conforming to and implementing relevant standards. To shortly sketch the status-quo situation of using multimedia digital resource collections already available, one can look towards broadcasting stations, music/video archives, record companies and libraries. It must be taken into account that collections are stored in different storage mediums, ranging from simple file systems, to relational database management systems to the growing number of object-oriented database management systems.[15] In addition, a large number of music catalogues in a variety of formats has to be also made accessible.[16]

Between library and library-like catalogues, an implementation of the Z39.50 protocol (version 3, 1995) is sufficient. For interfacing catalogues with relational databases, there will need to be a Z39.50 - SQL interface. There are very few relational database vendors who have implemented a Z39.50 support; one reason being that their "interoperability protocol" has been SQL, which has been universally accepted and implemented by almost all of the database vendors.

Discussions have already taken place to extend the Z39.50-1995 protocol with SQL.[17] From here it is logical step and a matter of time to stay interoperable with the present database generation which is based on object-oriented technologies, and has defined an object query language (OQL) and an object definition language (ODL).[18] With the prospective widespread use of digital libraries, object-oriented database management systems will become a major means of storing, accessing and using complex, multimedia data objects. [19]
Assuming a basic interoperability of different collections holding digital, multimedia objects, the underlying transfer protocol will have an influence on the performance, the quality and the representation means of the objects to be delivered. Using a stateless protocol, such as http, means that only one object can be delivered per session. Thus the connection closes after each document is delivered, losing all the information of the former session.

In devising a secure and distributed system, with collections stored in different locations, access handled from a central gateway and user access in the best case being controlled to a point of write, read and execute rights of

single objects and collections, stateless protocols can be a problem. Solutions lie in the underlying existence of user rights management, such as a database management system able to control the access of many users in dependency of objects or collection of objects, or/and the use of a stateful protocol such as Z39.50 or Hyperwave's HG-CSP.

PADS Hyperwave Information Server is able to handle these security issues, as well as offer an expandable protocoll layer. Relational Database management systems are hooked up to it by Perl Database Modules (DBI:DBD-ODBC, DBI:DBD-Oracle, etc). In cooperation with the AHDS, Index Data (Denmark) and Hyperwave R&D GmbH (Germany) a generic Z39.50-Hyperwave gateway was implemented, translating incoming Z requests into the object query language used by Hyperwave. With this gateway, the requirements of being able to access library catalogues, as well as relational database management systems, as well as other object servers was fullfilled.

3.2. PADS Database and Media-Server System

In the greater context of the AHDS, a central WWW-Z39.50 gateway residing at the AHDS is responsible for incoming requests for multiple-database searches via Z39.50. Z39.50 targets, installed at each of the 5 service providers including the PADS, process the incoming requests and send the result-sets back to the AHDS WWW-Z39.50 central gateway. The PADS also has its own gateways, providing their own specific user community with specialized services relevant for time-based media. Thus gateways to a number of clients is realized, such as www browsers, media-players, Z-clients, telnet clients, etc. Direct requests for subject specific searching is possible, with or without the use of Z39.50 protocols. The PADS resources reside on several database management systems, interoperable with each other through hyper-G, CGI and SQL interfaces. Hyperwave Information Servers are responsible for controlling incoming and outgoing requests from clients and interfacing databases. A, for this project implemented generic Z39.50-Hyperwave gateway was linked to the server, transposing incoming requests into the object query language used by Hyperwave. The hyper-G protocol allows proprietary clients (such as Harmony and Mozart) to have session-based protocols with graphical browsing abilities. These graphical representations of relationships of the objects in the DBMS are also realised with the http-Web gateway through Java/JavaScript implementations. The loss of functionality in using http, a stateless protocol, instead of statefull HG-CSP, is compensated by the use of Cookie files or java variables.

As the media server MediaBase on a separate Silicon Graphics Origin 200 is used. Movie players or soundplayers, either from MediaBase or those created by the University of Glasgow are able to make direct connections over the ATM networks. These players are installed on the client machines as browser plugins. Sound and movie objects are put into Hyperwave as objects, calling the functions by scripts to establish the direct ATM connection through Java classes and or C++ classes.

The PADS uses the feature of running several different web-gateways with different presentation schemes on different ports, in different colections and on different machines. The PADS is running two general webgateways at the moment, one serving webpages out for non-java/javascript browsers, the other utilising java and javascript in order to depict dynamically the resources and their relationships with each other. For specific data entry needs another webgateway is running at locations where collections are being archived, digitized and metadata'd. A fourth one is in development, to offer additional functionality needed for usage as a digital library service.

Interoperability between the HWIS and remote RDBMS/ORDBMS is supported through a HGI-SQL gateway. For example, to hook up a MS Access database, as the PADS has with a catalogue of a Glasgow -based film association, Hyperwave's own HGI (hyper-G Gateway Interface, using HG-CSP, hyper-G Client Server Protocol) communicates with its SQL gateway, which in turn interfaces to the standard available DBI-DBD perl-gateways. These have RDBMS vendor specific modules, such as DBD-Oracle, DBD-ODBC, DBD-Informix, etc. On the Access side, the only thing required is an MS ODBC or SQL server driver.

Another way used to link external sources to the Hyperwave Information server is by using the HGI (HyperG Gateway Interface) to call upon remote objects using as an additional attribute the protocol used such as http, telnet, Java Objects, CGI programs, etc. Mediabase, the database used by the PADS to store and deliver videos, is hooked up to the HWIS through the HGI. Metadata of videos and high quality soundfiles are stored on the Hyperwave Information Server, as is the protocol used for the delivery, but the BLOBs (Binary Large Objects) of

video or sound themselves are stored on Mediabase. The user thus accesses the videos through the Hyperwave Information Server, which builds up a direct connection between the client of the user and the Mediabase Server.

With this architecture, certain specifications demanded by a service such as the PADS are answered. It is an open but secure system running on a distributed resource environment with full user administration and rights management. It has, among other gateways, a web gateway and can be expanded by future gateways, answering the need of any upcoming specialized clients. It is interoperable with RDBMS and ORDBMS through SQL, and with its own object query language it is theoretically expandable with ODMG's OQL and ODL, linking it to OODBMS and distributed objects. It has powerful indexing capabilities and additional features deriving from the OODBMS world, such as versioning, inheritance of functionality, separation of content and view, and scalability of the delivery as well as the storage system.

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Footnotes

[1] http://www.ahds.ac.uk/ , 1998/07/01.
[2]http://www.jisc.ac.uk , 1998/07/01.
[3] http://www.ads.ac.uk/ , http://www.vads.ac.uk/, http://www.ota.ac.uk/, and http://www.hds.ac.uk/ 1998/07/01.
[4] http://lcweb.loc.gov/z3950 , 1998/07/01.
[5] http://www.netmuse.gla.ac.uk/ , 1998/07/01.
[6] http://www.music.gla.ac.uk/HTMLFolder/Research/SMaTBaM.html, 1998/07/01.
[7] This distribution of information has also implications reagarding copyright. I.e. Institutions holding copyright of material will likeky want to hold their collection physically on their servers and still be able to offers single user interfaces across remote collections. The National Preservation Office of the National Library of Australia has made this "Distributed responsibility" one of its Statements of Principles of Preservation of and Long-Term Access to Australian Digital Objects. See http://www.nla.gov.au/nla/staffpaper/preserve.html , 1998/07/01.
[8] See Categories of time-based Media: http://www.music.gla.ac.uk/HTMLFolder/Research/smatbam-private/categories.html , 1998/07/01, in [Boehm 1997 SmatBam].
[9] For an example of the separation of content resource and various representational views, one might think of a picture stored in the highest resolution possible in a central resource archive, and its compression to a lower quality for web use. When using high-speed networks, one would still be able to provide a higher quality resource to appropriate users or maybe an even lower quality one due to any possible copyright restrictions. In the computing world, this separation of content and representation has one of its object-oriented manifestations in the Model-View-Controller paradigm. The model being the content, the data, or a knowledge domain, the view being one possible presentation of it. The controller can be seen as the gadget maintaining the connection between the model and the view. One muiscal note, for instance, could be depicted in a system by an internal, proprietary data structure. To this note, one or more views can be "plugged in" as for instance a midi representation, a sound representation, and a graphic representation. Devising new views is thus independent of the content. See also [Ossenbruggen 1994].
[10] Elementary or simple objects are objects made out of one entity or one binary (text files, bitmaps, wave format files, midi files). Composite objects consist of a number of elementary or composite objects, for instance a complex/composite music data structure. Complex objects are objects with attributes that change in size.
[11] http://purl.org/metadata/dublin_core, 1998/07/01.
[12] http://ukoln.ac.uk/ , 1998/07/01.
[13] http://ahds.ac.uk/public/metadata/discovery.html , 1998/07/01.
[14] Most of the problems related to the use of the Dublin Core can be put down to its design of describing textual documents on the web. A very clear example for this is the "author" element, which works only for written documents. It does not work for music or many other disciplines, in which there are many more and different creators, which cannot described and would be even confusing in being described as being the author. Changing this attribute to creator makes it more elegant, but does not solve other problems, as for instance: a) Subelements or schemes of the Dublin Core are not yet standardized, as are the values in their syntax. (for example date, controlled lists, etc). b) Absence of any distinction between the digital item, which is represented in the system, and the physical item it might represent. Thus digital libraries using the Dublin Core face always the question of "Which metadata are we actually using, the one representing the digital object (for instance a image of a manuscript) or the physical object itself (the manuscript). Both sets of information might be important for a specialized user, but the Dublin Core has no option for this possible double existance of the object it is supposed to describe. c) Certain basic elements are problematic in their use in an interdisciplinary context, such as subject and coverage. For more information about the Dublin Core and it interdisciplinary evaluation at the PADS and AHDS, see [AHDS Metadata 1997].
[15]See examples: Time-Warner Pathfinder Personal Edition, http://pathfinder.com/@@5cnHOgcAhVYFFeXJ/welcome/ , 1998/07/01.- a personal magazine; the Chicago Tribune's Metromix, http://www.metromix.com/ , 1998/07/01, EDS, Aniamtion 200 , Liberation (Libraries: Electronic Remote Access to Information Over Networks), http://www.iicm.edu/liberation, 1998/07/01.
[16]Whilst in the academic and non-academic library world interoperability has established itself as an important topic, it is not so clear that, mainly commercial, television and broadcasting companies will want their archives to interoperate with those of their competitors. However, given that material tends to decrease in commercial value with time but increase in academic and cultural or heritage value, it is quite possible that their material will end up in such a collection and so issues of interoperability are worth addressing at the outset.
[17]See Proposal for SQL Access in Z39.50: Z39.50/SQL+, http://www.dstc.edu.au/DDU/research_news/reports/zproposal.html, 1998/07/01. It should be noted that although such plans are being discussed elsewhere, the AHDS' plans are limited to procuring specific interfaces between collection holders and Z39.50.
[18] ODMG 2, http://www.odmg.org/ , 1998/07/01.
[19] See the following research works and projects, which have been influenced largely by projects in cooperation with the Library of Congress: [Kahn and Wilensky, 1997], [Lagoze 1995] and [Lagoze 1996].

The Digital Beethoven House

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Abstract: The Digital Beethoven House is a digital library project of the Beethoven House Association, the City of Bonn, and GMD. It mainly consists of three parts. A digital archive contains digital copies of and catalogues about the collection of the Beethoven House and the Beethoven Archive. The Beethoven Salon is a real building which offers on-site access to the whole collection and additional visualization facilities about Beethoven's work and life. Finally it is a World Wide Web presence. This paper describes the services of the Digital Beethoven House to be implemented and the present project plan.

1. Introduction

Ludwig van Beethoven is the most famous son of the city of Bonn in the Rhineland of Germany. The composer was born here in 1770. Bonn became the center of the documentation and research about Beethoven's life. Beethoven's birthplace today contains a collection of more than 4000 original documents [Fig. 1]. They have to be preserved on one side for future generations and should be opened for the broad public and music research on the other side. Today's technology makes this possible.

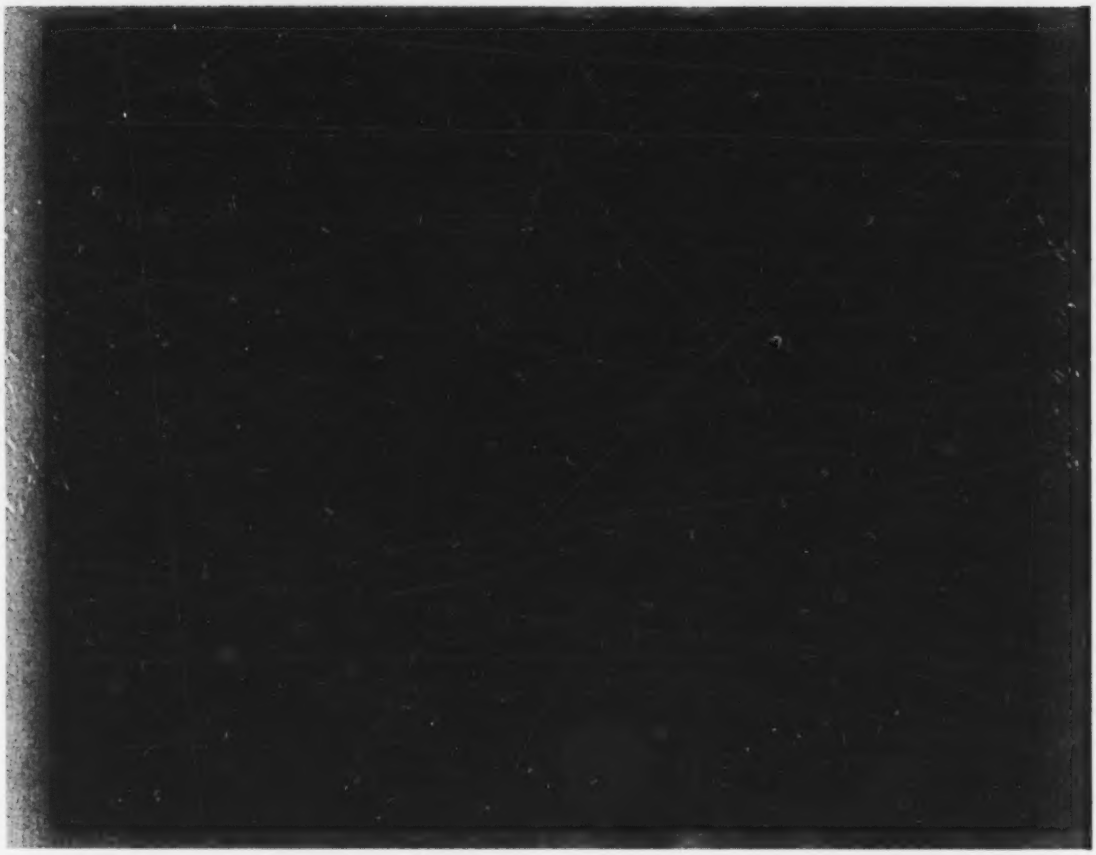

Figure 1: A Beethoven Manuscript

2. The Digital Beethoven House

The Digital Beethoven House is a digital library project of the Beethoven House Association, the City of Bonn, and GMD. It mainly consists out of three parts. A digital archive contains digital copies of and catalogues about the collection of the Beethoven House and the Beethoven Archive. The Beethoven Salon is a real building which offers on-site access to the whole collection and additional visualization facilities about Beethoven's work and life. Finally it is a World Wide Web presence.

2.1 The Digital Archive

Five main subjects dominate the design of the underlying database for the digital archive. The main part of the database will contain archive data concerning Beethoven's life and work (#1). On one hand the database will comprise Beethoven's own works like compositions, manuscripts, letters, sketchbooks, and autographs and on the other hand those documents where others dealt with his biography, the images of him, his surroundings, and working places, i.e. the whole Beethoven literature.

Additionally all the information about the Beethoven Museum of Bonn (#2) has to be part of the database including images, business hours, and all sorts of souvenirs which can be purchased. Moreover, all cultural events (#3), like concerts, exhibitions etc. are available in the database including the booking and reservation data.

Besides these informational data, the results of online working groups (#4) are saved to the database. These could for example be all the public contributions made to the forums for discussion or the examination and regeneration/restoration of musical handwritings. Finally it is in the own interest of the Beethoven House Association to organize their members (#5), the membership fees, the donations and all data concerning the advertisement in the data bank.

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2.2 The Beethoven Salon

The Beethoven Salon is a real building close to Beethoven's birthplace giving access to the Beethoven House and the complete Beethoven Archive. In the Beethoven Salon people have the chance to experience the ancient world of Beethoven through audio, video, and virtual data. The digital copies of all documents in the Beethoven Archive are here. A virtual guide will lead the visitors through the Digital Beethoven House. State-of-the-art visualization technology will give deep impressions into Beethoven's life and background. Interviews with Beethoven himself can happen based on modern videoconferencing technologies. Visitors can virtually touch the contemporary instruments and objects of the Beethoven House and can have a close look at the material and the mechanics used at that time. Last but not least, online studies can be made here.

2.3 Beethoven on the Web

Living in an Internet-based information society today, a global World Wide Web presence of Beethoven is a must. People planning their trip to Bonn will find all related information in the Web like opening hours, logistics, and travel information. An online booking service allows people from abroad to book one of the limited seats in the Chamber Music Hall, in advance and in time. Online catalogues of the museum shop will offer online purchasing possibilities.

2.3.1 A Beethoven Course for Beginners and Experienced

In order to connect the city of Bonn with the name and music of Beethoven, the Digital Beethoven House site will contain a course on Beethoven's music and life, which teaches the Beethoven friend as well as the scientist. The bilingual course (English/German) will also show step by step the whole offer of the Digital Beethoven House site like Beethoven's manuscripts.

The Beethoven course aims to provide a comprehensive learning platform which is motivating, intuitive, fun, and simple to operate so the user may immerse quickly into the content by using full multimedia Internet possibilities like text, picture, audio, and video. It is planned to make it the most complete Internet offer about Beethoven worldwide.

Another advantage of the Beethoven course is its ability to connect teachers, scientists, and other learners who study Beethoven via the Internet. They can communicate and exchange information fast and easily. By this, they form online working groups and their discussion results will be saved to the database too.

Additionally, the Digital Beethoven House Web server will contain: A virtual tour of the Beethoven House, compressed, low-quality versions (thumbnails) of the exhibitions and the documents in the collection, and catalogues about the archive as such. This Web offer may attract people coming to Bonn. Additionally, the Digital Beethoven House will maintain a guide to Beethoven research worldwide [BR 98].

2.3.2. Museum Support

The normal operation of today's Beethoven Museum will be simplified and enhanced by modern technology: It will base on the contents of the digital archive and Internet technology. Newsletters for the clients and the members of the Beethoven House Association will inform about events or new manuscripts for the Beethoven collection. A CD and facsimile production adapted even to individual user's/customer's needs, be it a private person or be it a scientist and researcher, will be part of the museum shop. Permanent exhibitions will perform here.

People doing research on Beethoven or having a generic interest in his work will find the URL of the Digital Beethoven House in all search engines directly. They can search for different types of documents in the digital Beethoven archive. They may have a look at them in a downgraded quality, make a choice, fill out and sign an invoice, and immediately download and use the document needed.

2.4 Challenges

The scanning equipment must be of high-quality as there are photographs, picture postcards, 3-D-compositions, books, magazines, newspapers, and even microfilms or microfiches to scan. The valuable primary material is either available as original or as copy or facsimile and often yellowed, soiled, and even fragile.

In a first step, technical metadata have to be stored during the scan process, like e.g. date, type, format, and identifier of the material, or the quality of original and scanned documents, the number of pages to be printed etc. Finally there is bibliographical metadata that have to be captured by cataloguers (music experts) in a second step. They comprise data like the title and the subject of a document, its description, its source, or its creator, and publisher or its contributor etc. The database of the library today ('allegro') has to be integrated

into this set-up. As the data will be accessible to other virtual digital libraries, standards for metadata, e.g. Dublin Core [DUCO98], will be evaluated against the cataloguing process.

Having digital copies of the Beethoven manuscripts has several disadvantages too. It makes it simple on one side to publish the documents but also makes it easy on the other side to manipulate the document, duplicate them or distribute them without the owner's approval. Content integrity, authentication, intellectual property, and copyright protection are the major issues here. It is technically not possible to prevent the unallowed manipulation, but it is possible to record the information about the owner, the application purposes, and the copyright in the document itself.

Watermarking, visible or invisible, is part of a solution for this problem. There is no standard method to embed and proof watermarks in digitized documents which browsers, operating systems, image processing software, and hardware devices can follow. There is no standard registration procedure for watermarks. This is needed for example for evolving search services, which have the task to find watermarked documents in the worldwide Internet, or for registries. About 20 products are on the market for watermarking with different procedures/algorithms implemented. An evaluation has to take place.

One issue in distributing digital objects is the granting of access rights to registered users all over the world ('pull technology'). Modern compression technologies and scalable coding can be applied here to limit the bandwidth usage during the transmission. More sophisticated distribution channels and policies will be implemented in the Digital Beethoven House.

3. The Project Plan

In June 1998, the budget commission of the German Parliament has devoted a large amount of Deutschmarks to the Digital Beethoven House in the context of its tourism concept for Bonn. With this decision, several activities performed by the Beethoven House Association and GMD since the end of 1996 came to a successful end [DBH 97]. The project is scheduled to start after the summer vacation period in October 1998. The plan is to demonstrate the complete Digital Beethoven House at the Expo 2000 exhibition in Hanover.

The project will start with a preparation phase where a feasibility study, a project plan, and a rapid prototype will be made. In a following design phase, a conception and a concept refinement for the Digital Beethoven House testbed and the overall system will be developed. The testbed will contain only a subset of the documents in the Beethoven House collection. In the next phase, the testbed and the overall system will be implemented. The testbed implementation will be accompanied by a scientific conduct study. Finally, after an integration of the overall system, the Digital Beethoven House will go into (pilot) operation following an operation model identified in the design phase.

Additionally, several permanent tasks have to be performed from the very beginning like project management, decision making, documentation, quality management, technology watch, and service adaptation and development.

4. References

[BR 98] http://www.music.sjsu.edu/beethoven/Research/research.html

[DBH 97] Birkenbihl, K., Bogen, M., Grigat, F., Ladenburger, M. (1997) Das Digitale Beethoven-Haus, Gemeinsamer Projektvorschlag des Beethoven-Hauses Bonn und der GMD - Forschungszentrum Informationstechnik GmbH, GMD, Sankt Augustin

[DUCO98] http://purl.org/metadata/dublin_core

Didactic Issues for Web Presentations

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The purpose of this session is to demonstrate and discuss ongoing projects at the University of North Florida. The presenters are instructors of two courses which are offered via the Internet. Middle School Philosophy/Curriculum is a required course in an undergraduate middle school education program. Telecommunications in Education is a graduate course. This session would help to disseminate information, to gain feedback, and to establish contact with those who are working on similar projects.

Topics of discussion include, but are not limited to: Effective Lessons, Objectives, Estimating Student Time, Frequency of Assignments, Collaborating on Assignments, Measuring Technological Skills or Achievement in the Content Area, Accessibility of Technology Resources, Types of Assignments, Electronic Discussion Areas, Face-to-Face Meetings, and Streaming Video/Audio.

Web-Enabled Distance Education Environment

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Abstract: As the new network computer technology forces into every aspect of daily life, many things change in a rather rapid way, compared to what we were used to until recently. One of the most important aspects in the social activity of people, Education, could not be an exception. Advances in network infrastructures and telematics services, combined with multimedia techniques and powerful personal computers provide the opportunity to make a network-based multimedia system for distance learning (teletraining) a real fact.

Introduction

The value of accurate and on-time data and information in world-wide range towards the Information Society, has altered the needs for education. Today, instead of having "once-in-a-life" education, is more likely to follow the pattern of "life-long" learning. The concept of Teletraining is able to replace the time-and-money-consuming status of moving around in order to acquire the knowledge needed, since via computer networks the experts can give their knowledge to all that have access to the Web. Additionally, an unlimited variety of themes can be provided by a PC, in the context of a well organised, easy-to-handle, brief or detailed, continually updated lesson.

The potentials of Teletraining has prompted many Software Development Companies and Educational Institutes (Universities, Colleges) to invest and work on it. Microsoft has already developed and distributed NetMeeting, which provides the ability of working collaboration between users in different locations, using TCP/IP protocol suite. NetMeeting provides point-to-point video and audio real time communication, multipoint data conferencing and application sharing. It can also interact with other multimedia network applications provided that they support the same ITU-T standards that NetMeeting use.

Another tool that can be used for teletraining purposes is WhitePine's CU-SeeMe 3.0, which among others supports Phone Book with Graphical Contact Cards, Directory Services for locating other CU-SeeMe users, H.323 Standards based video codec (H.263), White Board (T.120), Motion JPEG (M-JPEG) video codec for high quality and video over LANs and ISDN. However, the most significant functionality of it is the TCP/IP support for LAN/WAN conferencing, using the reflector policy, with the ability to view up to 12 participant windows simultaneously, supported by Caller ID for incoming connections and Parental Control Management.

What has been mentioned above, have inspired and motivated the research efforts that resulted in the design and implementation of a "synchronous" distance education environment using WWW, which represents the continuity of the research work that has started three years ago in the Telematics Laboratory of Computer Engineer and Informatics Department (CEID) and Computer Technology Institute (CTI). Telematic services are used for the conduction of lessons over computer networks and this environment can be thought of, as a simulation of a traditional classroom setting with the live presence of a teacher, where all interactions among students, teacher and courseware can be realised.

General Architecture of Teletraining Tool

The overall architecture is based on the Teletraining Server, that is responsible for the communication between the trainer and the trainees. The main idea of the proposed architecture is to setup a single Teletraining Server per Training Center. The concept of the Training Center is a powerful computer with a Web server and the tool's Teletraining Server installed. All the slights needed for the lesson will be stored there and for everyone taking part in the lesson, the computer will function as a reflector for the audio, video, chat, and White Board

data. The Server is capable of taking over multiple lectures. Furthermore, the interaction between the trainer and the trainees is performed by the Server, which implements the commands of the users.
Both the trainer and the trainees are connected to the Server through custom designed Clients that provide them with the ability of interacting with the Server through a user-friendly Graphical User Interface (GUI).
The major advantages of the proposed architecture are:

- Interactive communication between teacher and students over the Internet, including audio, video and data exchange.
- Modular design in the sense that the application specific network protocols are exclusively responsible for the interaction between the Clients and the Server.
- The physical appearance of the trainer is not required at the Teletraining Center since he can manipulate the lesson, through the Teletraining Server, from his PC provided that there is installed the trainer's client software, which interacts with the Teletraining Server.
- Uniform approach of the Graphical User Interface of both the trainer and the trainees. The different functionality of the Clients for the trainer and the trainees is implemented by means of enabling and disabling controls of the User Interface and the corresponding modules of the application.
- Ease of use. The user interface is designed in order to hide from the user most of the low level details that are needed for the interconnection of the various computer systems over the network.
- Being an opened-environment tool since it was developed in Java, in order to work independently of platforms.
- Reduced costs for development and administration and increased flexibility. This implies that a single Server is capable of taking over multiple lectures given by different trainers. Thus, the effective operation of the Teletraining Tool requires the setup of a single Teletraining Server per Training Center.
- Provision of interesting lessons incorporating JPEG, GIF images and offers a variety of tools that can be used to enhance these images with remarks and drawings, thus making the lesson material interesting and attractive.

It is obvious that the software tool can be put into immediate use through the use of TCP/IP protocol suite, and can greatly aid the implementation and realisation of the distance education service. This use can offer a number of advantages to the persons that will attend the classes, among which are the following:

- The trainees do not suffer from lost productive time, since they have the flexibility to attend the lessons in more negotiated time periods, even outside their work hours.
- The creation of friendly and continually modified lessons can instigate the interest of the trainees for them.
- The use of Telematics reduces the need for experts and the cost of the educational process.

A very significant characteristic of the tool is the selection of JAVA as the programming language with which it was developed. During the design phase, it was considered crucial the demand for full portability of the tool. That is, the tool should be able to be executed independently of the workstation of the user. It should be able to work either under Windows 95 or a UNIX System or a Macintosh. At the same time it should have the ability to use the Internet infrastructure for reaching every potential user. In order to achieve what was mentioned above and to build a very easy-to-use tool as well, JAVA was selected.
As a result of the above, the server of the Teletraining was implemented as a JAVA application. The server should be installed in each Training Center in the same workstation with a Web Server in which all the Web pages that a lesson would use, reside. The client of the Trainer on the other hand, is also a JAVA application that should be in each trainer workstation. It can be locally executed in order either to build and prepare a lesson and later to store it in the Teletraining server or to actually conduct a lesson in real-time.
The client package of the trainee though, is consisted of several JAVA applets. Each applet is responsible for the respective functionality (Chat, White Board, Text Editor, Audio Communication, Videoconference). All the applets resides in a single workstation and can be accessed by every trainee through a Web Browser (Internet Explorer, Netscape Navigator) as easily as they reach any other address in the WWW. The only restriction is that the trainee-user should have acquired previously a Login and a Password from the Teletraining server, using the appropriate Web pages for registration in a lesson.
In the following, a complete functional specification of the Server and the Clients will be given.

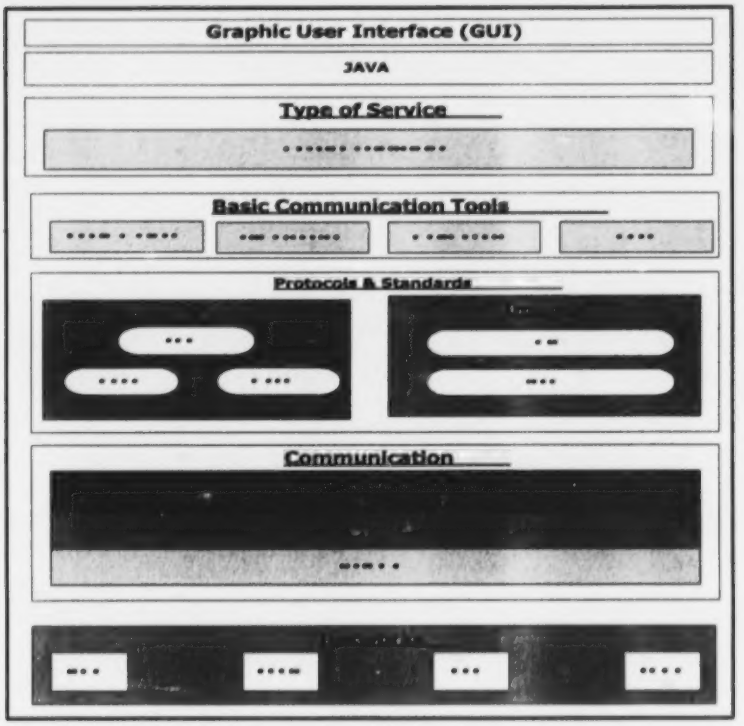

Figure 1. Protocol stack.

Functionalities of the Teletraining Tool

Functional Specification of the Teletraining Server

The Server of the Teletraining Tool is responsible for the interaction between the trainer and the trainees before and during the lecture. More specifically, the Server provides both the trainer and the trainees with the following services:

- Lecture Announcement. Once a lecture is prepared, the Teletraining Server uses the network to announce it by notifying all possible interested trainees, possibly by a bulletin board system, a WWW server, or a mechanism of distribution lists. The notification consists of a simple announcement of the lecture that calls the potential trainees for participation.
- Lecture registration. Trainees that have been notified, can simply register their interest in the lecture. The Server automatically registers the corresponding trainees in order to deliver the course material to them and to automatically handle the network connections during the lecture.
  - Distribution of the material for the lecture. After the registration process, the material for the lecture is distributed to all the trainees that will participate to the specific lecture. The Server is exclusively responsible for the distribution of the material, that may take place either before (off-line) or during the lecture (on-line).
- Access to previous lectures' material. The Server stores previous lectures' material so as to provide access to them to any interested trainee. Thus, the material of any previous lecture will be available to all the trainees for later review.

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- Lecture presentation. During a lecture, the Server will operate according to the commands of the trainer so as to ensure the proper presentation of the lecture to the trainees. Furthermore, the Server offers the following operations:
  - Submission of written questions from the trainees. The written questions are transmitted to the trainer. The trainer answers the questions and both the questions and the answers are transmitted automatically to all the trainees.
  - Submission of requests for oral comments. The trainees have the ability of inquiring and the trainer will either accept or reject the inquiries. In the former case, the trainer will give permission to the requester and the oral comment will be broadcast to all the participants of the lecture.
  - Session management. Because of the nature of the multiple data types that have to be transmitted during a lecture, some media handlers that will take over the synchronisation and the appropriate representation are necessary, especially when dealing with audio, video, high quality images, and structured documents. Another handler will be responsible for the interaction among the trainer and the trainees.

Functional Specification of the Trainer's Teletraining Client

The trainer's client is meant to give the opportunity for the preparation and presentation of a lecture to a selected audience through a friendly user interface. This client interacts with the server in order to guide the lecture according to the trainer's will. Within these directions the trainer's client provide the following services:

- A tool for the creation of lectures. Each lecture will be prepared from the trainer with this tool. It consists of a hypermedia document that will be described in a suitable language and consisted of several slights. For all the slights of a lecture is assigned a hierarchy of dependencies which organises the notional succession of it. A similar hierarchy exists for a group of lectures comprising a seminar. Each slight might consist of text, still images and connections that would refer to others slights or files of audio or video. The tool for creating slights provide the following abilities:
  - Creation and processing of slights
  - Request and acquire information from the WWW
  - Notional succession of lectures and seminars
  - Update the lecture announcement's board
- Off-line reading and processing of existing lectures. This functionality holds only for the trainer that created the lecture or someone who has the appropriate privileges.
- Selection of the audience. It allows the trainer to select the members of his audience from those who requested permission to attend a lecture.
- Guidance of the lecture's flow. During the lecture, the trainer interferes dynamically in the flow of the lecture. Thus, the client interacts with the server in order to execute the wills of the trainer. As a result the following abilities are supported:
  - Interchange and annotation of the slights. That can be done by notes, underlying, natural speech and video with the face of the trainer whenever is possible.
  - Admission and answering of the possible questions by the trainees. The trainer is able to admit or not written questions or requests for oral statements. He can also respond with orally speak or by writing to any kind of a question. Moreover, he can withdraw anytime the permission for speaking from any of the trainees. Finally, he controls the flow of questions/answers to the rest of the virtual class.

Functional Specification of the Trainee's Teletraining Client

The trainee's client is a tool that requires only a Web browser in order to be executed. It enables the trainee to attend a lecture and to interact with the trainer through the teletraining server. It specifically provides the following services:

- Lecture's Attendance. There exists a White Board for the slights and a space for text that accompany them.

- Questions. Ability for interaction with the trainer in order to submit questions written or audio-recorded.
- Display of the trainer in an embedded window (video) in the central interface of the application. Ability to disable that window if the available bandwidth is not able to support the live broadcast of the video of the trainer. A similar ability is provided for the audio support.
- Store/Delete of lecture. The lectures or specific parts of them that are selected from the trainee can be stored locally in their workstations for future use.

User Interface

Trainer's Client

The Trainer through the basic menu "Server", "Server Location" has the ability to specify the server's Internet address and afterwards to connect to the server pressing "Connect Server" from the basic menu "Server".
Using the "Window" menu the trainer can choose any time which of the Services (White Board, Chat, Video, Select Slights, Selected Slights, FTP, Statistics) to be on the screen.
All the available slights for each lesson can be loaded from the trainer through the Select Slights Service. Successively, the trainer chooses the specific slight at the order to be displayed on all clients.
Upon that slight he can add some drawings (rectangular, straight lines, consecutive lines, etc.) and text using the White Board menu. Finally using the Chat Service he can send to all trainees text messages guiding the lesson and give the opportunity to the trainees to break in the session.

Trainee's Client

Every trainee can access a session using a Web browser in order to run the client's applets. Before that, he should enter the server using his Login and Password which he should have acquired previously by the server.

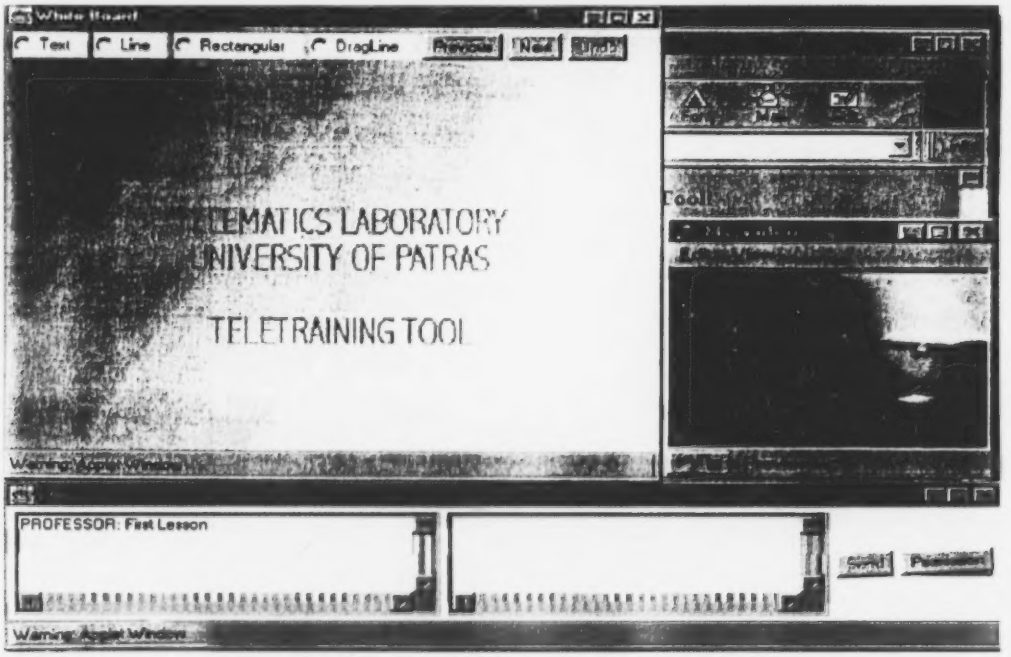

Figure 2. User Interface of the Trainee's Client

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Entering the server with the Login and Password, the applets are executed automatically and the trainee could then choose which windows (Services) he wants to be active.
In the Video window, he can watch the face of the trainer. If the network bandwidth cannot support this service the trainee can deactivate that service.

Conclusions and Future Work

Initially, the Web was a mechanism to retrieve distributed information, with little interaction available. Java now allows full interaction with server and discussion with other users. It also enhances the Web's functionality by allowing a collection of Web-based documents to serve as a focus for synchronous collaborations.
In the present implementation the teletraining server controls thoroughly the lesson's flow. That allows the trainer to manipulate the lesson according to his will. On the other hand the fact that the server operates as a reflector for video, audio streams and for the White Board and Chat data, creating one connection for each user, the bandwidth required for a large number of trainees would be prohibitively big when all services are enabled.
In order to solve the problem that is described above, we have planned for future work to make the application use the Internet's MBONE technology, which JAVA gives the opportunity to take advantage of.

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Sonic Hyperlinks: Hypermedia Methodologies Applied To Audio For WWW-Based Teaching Applications

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Abstract: The transfer of Hypermedia methodologies to audio in the World Wide Web is discussed introducing sonic hyperlinks. Sonic hyperlinks are links annotated within an audio stream that lead to arbitrary multimedia content. A system architecture and implementation relying on commercial WWW technology like RealMedia is presented. The system includes an authoring tool as well as the necessary presentation plugin for an Internet browser. As an example application sonic hyperlinks have been used for WWW - based teaching and training.

1 Introduction

Hypermedia methodologies like links in hypertext are an essential feature of WWW - based training courses compared to traditional media. However, hypermedia methodologies have not been applied within the audio content of WWW pages in contrast to text content (hypertext) or graphical content (imagemaps, video hyperlinks).

There are few graphic systems like [Martel 96] utilising the audio channel. The sonification systems of [Brewster 97] add sonic information on graphical interfaces. Systems for blind users [James 96] translate graphical information to sonic information. Systems without graphic output like [Stiefelmann 96] use the audio channel to give information to the user. However, all these systems do not integrate and represent hyperlink annotation of the audio stream in the audio stream itself.

Enhancing the audio channel with an intramedial hypermedia structure offers an alternative to the visual channel. This is especially important if information is not redundant in the sense that it is only provided on the audio but not on the visual channel. In some hypermedia systems a somewhat artificial solution for this problem is to show additional, isolated textual hyperlinks [Martel 96]. Relating audio information to textual hyperlinks, however, is not easy to perform for a user and distracts his attention from the actual information. Using in audio represented hyperlinks offer the advantage of a close relationship between information and annotation. Sonic hyperlinks are expected to be more intuitive as they are closer to natural communication where it is common to inquire additional information in a talk. Besides, all users are able to listen to different audio streams, and thus telling audio information from hypermedia annotation, by taking advantage of the 'cocktail party effect' [Arons 92]. Annotated audio streams are a non-used interaction potential on most audio-visual presentations.

2 Sonic Hyperlinks

In this section we deal with the question what constitutes a sonic hyperlink, i.e. hyperlinks annotated within an audio stream that lead to arbitrary multimedia content, and what requirements a system that support sonic hyperlink has to fulfil.

A sonic hyperlink works as follows: the author integrates the hyperlink in the audio stream and defines what happens if the user would like to follow the link. This additional information is transferred via the WWW to a user. When the hyperlink is presented to the user a certain sound is played in parallel to the regular audio. If the user reacts using a certain interaction metaphor in a certain time interval a system reaction occurs as defined by the author. Thus, these are the major criteria for the sonic hyperlink:

- The link area of the audio information that is annotated, this is the hyperlink start- and stop-time.
- Time-delay for the user reaction (delay after hearing the sonic hyperlink).
- The sound that represents the sonic hyperlink (e.g. earcons [Brewster 97]) eventually indicating different kinds of information.
- The link target of the hyperlink (e.g. URL).
- The user interaction metaphor (e.g. keyboard stroke, mouse click, voice entry).
- The hypermedia navigation metaphor (e.g. button, voice commands).
- The system reaction (e.g. target windows, presentation break, rewind of the presentation).

3 System Architecture and Realization

A first architectural decision to be taken is whether the sounds for the sonic hyperlinks are integrated in the audio stream, send in an separate audio stream or timing information is send. The first solution does not allow the user to modify the sonic hyperlink representation. Currently, however, WWW video servers and clients do only support the first solution. We chose this solution as our aim was to use a commercial Web video server with an API. Here we selected the RealMedia Web video server [Hefta-Gaub 97]. RealMedia has established itself as a de facto standard on the World Wide Web. The benefit of this Web video server is that it provides in addition visual hyperlinks on the video stream, synchronized Web-pages and a Java application programmers interface.

For authoring we conceived a graphical tool that requires start time, stop time, URL, hyperlink sound and volume from the author. The tool is implemented using the RealMedia authoring API which is able to give a Web-page a push-time relative to the presentation time of a audio-visual presentation. We mark these Web-pages as sonic hyperlink target URLs and give them two push-times: The first at the start-time, the second at the end-time of the sensitive time of the sonic hyperlink. This is stored in an RealMedia stream. The sound of the sonic hyperlink is mixed with the audio stream exactly on the sensitive time of the sonic hyperlink, the result is stored in a second RealMedia stream. These two streams are stored together in a third RealMedia stream which represents the annotated audio stream. This annotated audio stream may be linked with a video stream or pushed Web-pages to a multimedia presentation.

For transmission, the multimedia audio-visual presentation is served through the Internet via a non-modified RealMedia Web video server.

For presentation, the multimedia audio-visual presentation is received by the RealMedia Web video client. This client is controlled by a Java applet. The applet checks the server-pushed Web-pages for the sonic hyperlink mark. If it detects one it holds back the server-push, waiting for a user reaction, this until the second push of the marked page. A potential user reaction is served to the applet via its reaction interface. If the user reacts the applet pushes the Web-page. The applet stops the presentation (if adjusted) and resumes the presentation as specified.

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Designing Counselling Systems for the WWW

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Abstract: In this contribution we present the INTERAPIE system for counselling via the WWW. Based on existing protocols for face-to-face treatment of traumatic or stressful life events, an application has been developed that allows patients and counsellors to interact via the WWW. The interaction mainly consists of patients writing essays following assignments set out by counsellors. The INTERAPIE system uses a database in which all relevant information is stored. The WWW pages are adjusted to the activities performed by the patients and the counsellors and are generated automatically on the basis of the contents of the database. The INTERAPIE system is different from typical WWW applications that are often 'search-oriented'. The INTERAPIE systems supports task-execution, i.e. it provides the tools that help the patients and counsellors to carry out activities as required by the protocol for treatment of traumatic or stressful life events of these patients. What kind of additional constraints follow from constructing this type of WWW applications is the research topic underlying the INTERAPIE project.

1. Introduction

Research has demonstrated the positive effect of writing assignments in the treatment of individuals (patients) who have suffered traumatic or stressful life events, e.g. [Lange 1994, Schoutrop 1997]. Treatments of this kind rely heavily on systematic confrontation with the stimuli. The hypothesis is that successful treatment results in habituation to emotionally painful stimuli. This habituation facilitates overcoming of the traumatic event. An important feature of the therapy is the largely fixed structure of the counselling procedure. A typical treatment is organised as follows. The patient writes essays about the traumatic event. The counsellor reads these essays and gives feedback with respect to what issues to focus on next. After a certain number of writing sessions the patient engages in a kind of ritual. This ritual usually consists of one more writing session followed by some procedure to symbolically remove the problem, e.g., by burning or burying this last piece of text.

There are a number of reasons why the counsellors that we are working with want to investigate the usability of the WWW as a communication tool between patient and counsellor [Lange and Emmelkamp 1997]. One reason is the assumption that the availability on the WWW will lower the barrier for people to engage in a counselling situation and that thus more people will be able to get help in solving their emotion problems. This lowering of the barrier can be explained by more then one argument. For example, as soon as counselling can be done using the WWW people can take therapy while staying at home. So it simply takes less effort to get started. An other issue concerns the fact that people don't easily go to a counsellor because of the anxiety that such an activity brings about. This is mainly a social or a cognitive barrier. A second reason for investigating counselling via the WWW follows from the fact that many people spend a lot of time communicating via the WWW (chatting, etc.). Apparently this way of 'talking to someone' is appreciated. There is also evidence that people 'tell more' on the WWW then they do in face-to-face meetings [Postmes 1997]. Consequently, using the WWW might be beneficiary for the therapy itself, because one of the key ideas of the counselling procedure is to have patients write extensively about their emotional problems.

Whether the counselling procedure works, and works better using the WWW, is not part of the research discussed in this paper. Here we focus on the design question, i.e. can we build an application for the WWW that facilitates task-based support for counselling situations. Many applications on the WWW are search-oriented'. Users surf the WWW in order to obtain information. Not many applications on the WWW support the execution of a task, although there are some examples in the domain of education [Parker Roerden 1997]. The realisation of task-based support for counselling situations is complex. At each point in the therapy the patient is required 'to specifically do certain activities' and 'may not do other activities'. The same holds for the counsellor. This situation is further complicated by the fact that what 'must' or 'may not be done' depends on the previous activities of the patient and the counsellor.

A second research topic concerns the difference between a task-based application on the WWW and a more regular 'stand-alone' application. Many things are known about the latter, which is not the case for applications on the WWW. Typically users can access the WWW when it best suites them. This is a problem

for task-based applications on the WWW when the type and frequency of the interaction between the different parties is crucial. Almost needless to mention that this is the case in counselling situations.

2. The INTERAPIE System

In this section we describe the INTERAPIE system (http://www.psy.uva.nl/interapie). This version of the system is the first full implementation and has been used in experimental try-out sessions involving real patients and counsellors. How the INTERAPIE system was developed and what kind of ideas are behind this version of the system will be discussed in the next section.

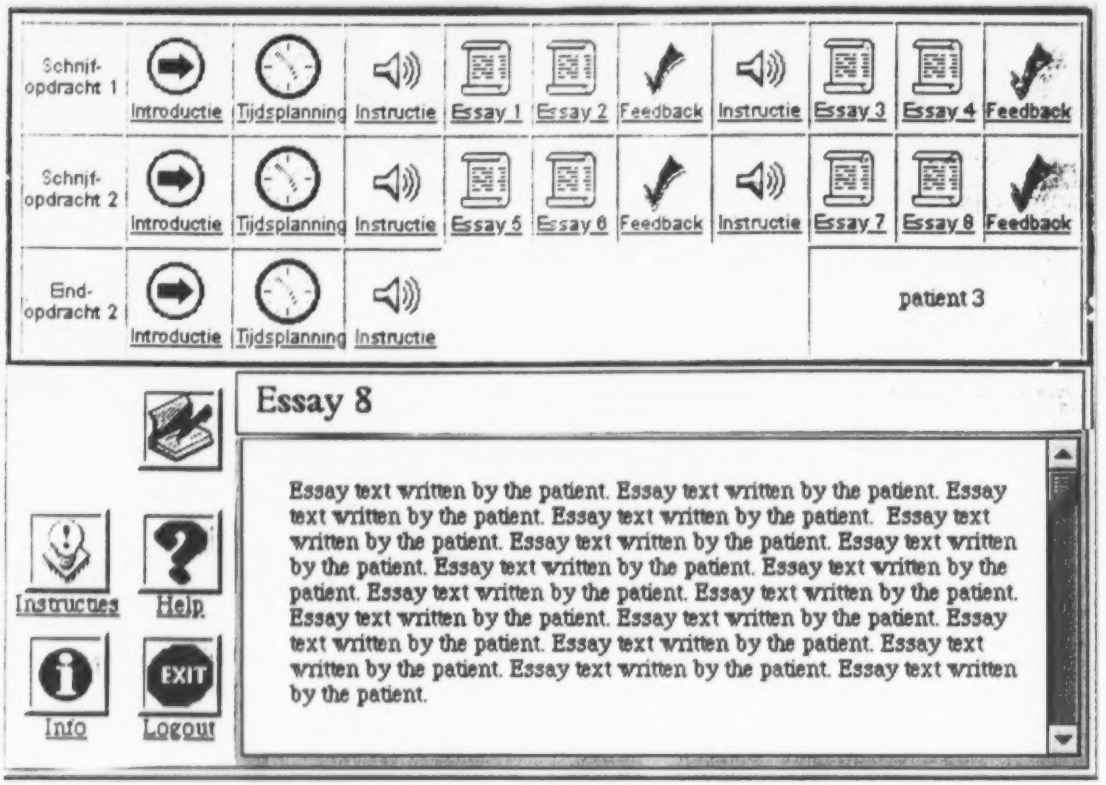
Schrijf-opdracht 1
Introductie
Tijdsplanning
Instructie
Essay 1
Essay 2
Feedback
Instructie
Essay 3
Essay 4
Feedback
Schrijf-opdracht 2
Introductie
Tijdsplanning
Instructie
Essay 5
Essay 6
Feedback
Instructie
Essay 7
Essay 8
Feedback
Eind-opdracht 2
Introductie
Tijdsplanning
Instructie
patient 3
Essay 8
Essay text written by the patient. Essay text written by the patient. Essay text written by the patient. Essay text written by the patient. Essay text written by the patient. Essay text written by the patient. Essay text written by the patient. Essay text written by the patient. Essay text written by the patient. Essay text written by the patient. Essay text written by the patient. Essay text written by the patient. Essay text written by the patient. Essay text written by the patient. Essay text written by the patient. Essay text written by the patient. Essay text written by the patient.
Instructies
Help
Info
EXIT
Logout

Fig. 1. Screen-dump: Overview Counselling Situation for Patient 3

When consulting the INTERAPIE WWW site a patient has two options: reading general information about the system or signing up for counselling. In the case of the latter INTERAPIE starts the screening activity. Each patient has to fill out a number of questionnaires. The questionnaires have two purposes. They are used to deny access to the system for patients that cannot be helped by the kind of treatment implemented in the INTERAPIE system. The second purpose of the questionnaires is concerned with information gathering about the patient that might be of use during the counselling. The screening is largely automated, i.e. the answers provided by the patient are stored in a database and procedures have been implemented to decide whether a patient can be allowed to use INTERAPIE. In the case of exclusion, the patient is presented a message explaining why he or she cannot be allowed to use the system. Additional information is given about where the patient may seek help instead.

Only one part of the screening is not automated. This part concerns the use of medicine by the patient. It was felt by the counsellors that this issue was too complicated to automate. In the current version of the INTERAPIE system the patient has to fill out a questionnaire about use of medicine. The information provided by the patient is presented to a counsellor who decides whether the medicine situation of the patient is problematic for the treatment as it is implemented in the INTERAPIE system.

Before the treatment may start a patient has to fill out an 'informed consent' (IC). This is a formal document including a signature of the patient by means of which the patient formally agrees to be part of the research project, and thus that the information about the patient's treatment (although anonymous) may be used for research purposes. Filling out an IC is a standard procedure in the Netherlands for doing psychological and clinical research with real patients. The handling of the IC could not be done fully automatic, because it requires a written signature of the patient.

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If the screening is successful, the next main activity in the procedure is carried out by the counsellor. The counsellor has to construct an introduction ('right-arrow' icons in figures 1 and 2) for the patient. Most of the text needed for this can be taken by the counsellors from sets of pre-canned sentences, but the counsellor is free to deviate from this. Notice that, patients when they enter the INTERAPIE system are assigned to a counsellor ad random, although the assignment procedure makes sure that each counsellor has approximately the same number of patients.

Next the patient has to plan the first sequence of four essay writing sessions. This activity is shown to the patient in the interface by means of a 'clock' (figure 1, top row). By clicking on the icon a new WWW page is generated that allows the patient to plan the writing sessions. The planning tool implements certain constraints. For example, two essay writing sessions have to be separated by at least one 'free day' whereas at the same time there is a limit in the total amount of time that the four essay writing sessions may take (two weeks).

After the planning, the counsellor has to construct the specific instruction for the first two writing sessions (illustrated by the 'loudspeaker' icon). Next the patient performs two essay writing sessions followed by feedback and new instructions for the next two essay writing sessions. This first part of the treatment finishes with a feedback constructed by the counsellors on the third and fourth essay writing session. The second part of the treatment (Schrijf-opdracht 2) smoothly follows the first part and has the same set of activities, although the instructions, feedback, etc. will now have a different contents.

After finishing the second part, the patient proceeds with the ritual (figure 1, Eind-opdracht2). In figure 1 only a fraction of this third part is shown. The patient has just received the instruction specifying what to do next and is currently reading a previously written essay (nr. 8).

The counsellors may use pre-canned sentences for these activities. In fact, the counsellors that we are working with favour the use of such sentences because it improves the similarity between the treatments of different patients and thus provides them with a better situation for evaluating the usefulness of the treatment. INTERAPIE also supports the counsellors in how to read the essays written by the patients. However, none of the activities that have to be carried out by the counsellors are automated. Hence it is always the counsellor who interacts, although via the WWW, with the patient. This was also seen as an important requirement by the counsellors.

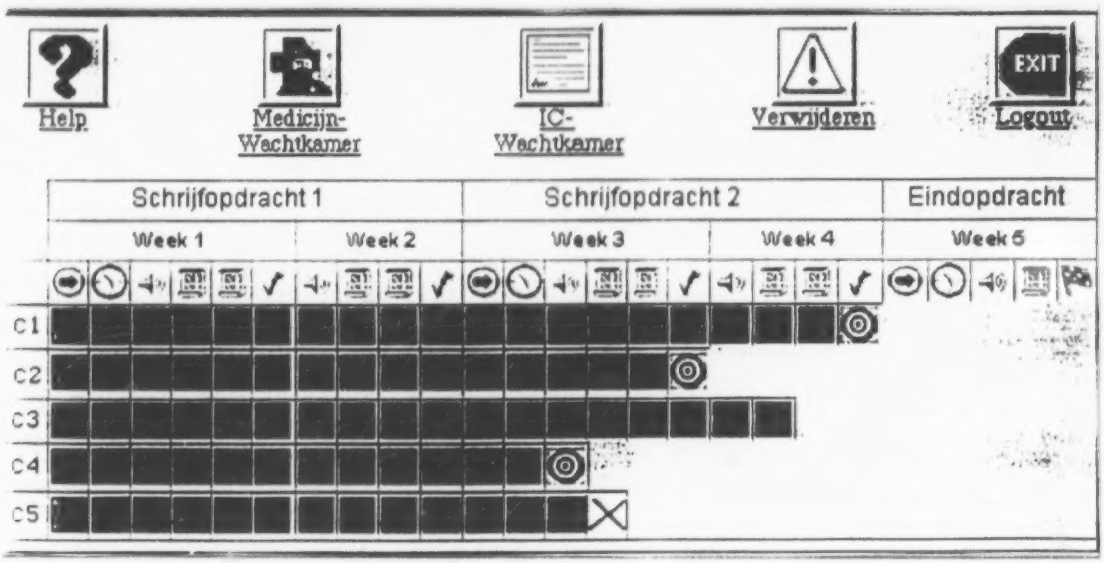

Fig. 2. Screen-dump: Overview Counselling Situations for Counsellor.

A number of other things are worth mentioning. The set of icons in the patient interface that illustrate the activity that has to be carried out, and those that have been carried out, grow while the treatment is underway. In the beginning there is only the introduction icon. When the patient has made the planning, and the counsellor has 'replied' by constructing the instruction, the related planning and loudspeaker icons appear in the patient interface, etc. So the patient doesn't know beforehand how the treatment will proceed. Instead this is made clear to the patient, step-by-step, while following the treatment. At the left-hand side in the patient interface, five icons are shown that illustrate general issues. The topmost icon, currently showing a book and a pen, changes during the treatment, i.e. it always illustrates the activity that has to be performed. So we can infer that this particular patient has to write an essay, probably his or her final one. When clicking on the 'book

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and pen' icon the patient is presented a new WWW page which is basically a full-screen text-editor. When the patient is finished with writing, the essay can be saved and the patient can go back to the overview pages. The 'essay' icon then appears next to the instruction icon, meaning that this activity has been completed.

The counsellors mainly construct feedback and instruction. For these activities a dedicated interface is available. A counsellor usually has a set of patients (C=client) he or she is counselling at a certain moment. Therefore the counsellors must have means to easily overview the different counselling situations. This is realised by the interface part shown in figure 2. In fact, this is the screen the counsellors starts with after logging on to the INTERAPIE system. As all patients go through the same protocol an overview is generated by making a kind of table matching activity to patients. The black squares under the icons show activities that have been completed. At the end of each row, the current situation is highlighted. The red circle for patient 1, 2 and 4 means that the counsellor has to do something (feedback for 1 and 2, instruction for 4). At the end of the row for patient 3 no special cue is provided, which means that the patient has to do something. Sometimes a patient runs late with respect to his or her schedule. In such situations, a special icon is placed to illustrate this being late (patient 5). By clicking on one of the rows the counsellor gets into a workspace that matches the activity that has to be carried out. Finally, at the top of the interface five icons are shown that illustrate general activities. Respectively from left to right they represent: general help, new patient who's medicine situation has to be analysed (medicijn wachtkamer), new patient who's informed consent has to be checked (IC wachtkamer), the possibility to remove a patient from the INTERAPIE system (for instance because he or she has not followed the agreed upon schedule) (verwijderen), and logging out.

3. Designing and Implementing the INTERAPIE System

The development of INTERAPIE was done using a User Centred Design approach [Preece 1994]. During the first phase (requirements analysis) interviews were held with the counsellors in order to find out details concerning the original face-to-face treatment based on writing assignments. During this period we also tried to define the requirements for the INTERAPIE system. Next a task analysis was carried out to further specify the roles and activities during a counselling period. The third major effort concerned the design of the user interface, both for the counsellors and the patients. After that the INTERAPIE system was implemented and tested.

The task analysis was very important to the development of the INTERAPIE system. During this phase the tasks that the INTERAPIE system must perform were defined. Were needed these task were further decomposed into sub-tasks, until for each sub-task a detailed data-flow was available that clearly showed how the task could be implemented. Task analysis is not just concerned with specifying the tasks. Also important is task-allocation and the construction of a data-model. The former defines for each task the agent that has to perform it. In the case of our counselling situation, three agents can be defined: the INTERAPIE system, the patient and the counsellor. The data-model provides the basis for the construction of the database. It also specifies the data types that can be input and output of the tasks. The complete task analysis consists of specifications for approximately 50 data-flow diagrams for the leaf-tasks, i.e. the tasks at the most detailed level of specification.

While constructing the task analysis a number of remarkable issues emerged. Particularly, between counsellors conflicting statements were made about how certain treatment details should be realised in the INTERAPIE system. The counsellors also had a tendency to sometimes change their ideas during the constructing of the task analysis. Both facts illustrate the fact that the counsellors were still in the process of refining their ideas on the INTERAPIE system. In fact, many of the low level details have been decided upon while constructing the data-flow diagrams for the INTERAPIE system. When following a user centred design it is the task of the knowledge/software engineer to make sure that the domain experts reach a consensus on these issues. There were no major bottlenecks in this respect. The data-flow diagrams were finalised by defining a control structure on top of the tasks. The control structure specifies the exact order in which, and conditions under which, tasks have to be executed in the INTERAPIE system. To further minimise the step towards the implementation, this control structure, was then re-written in a semi-formal language.

The next crucial step in the design of the INTERAPIE system concerns the interface design, i.e. how do we visualise the interaction of the system with the patient and with the counsellor. This was a difficult problem to solve. One discussion focused on the question whether the interface should be 'text-oriented' or use mainly graphics. It was decided that the latter was the best option. An important reason being that icons can be used to illustrate many concepts, while usually only using little space in the interface. It was soon recognised that both the interface for the patient and for the counsellor would become very full otherwise.

In order enforce that both patients and counsellors follow the activities as scheduled in the treatment protocol, little cues have been used to highlight the next activity. First, the interfaces only visualises the activities that have to be carried out next (the last icon in the row), and the ones that have been done before. The current activity is further emphasised both in the interface for patient and for the counsellor. In the case of the former an additional icon is used to point to the current activity: in figure 1 the book and pen icon

illustrating that an essay must now be written. In the case of the counsellor the current activities are emphasised by a red spiral (figure 3).

The treatment requires a strict schedule for carrying out the required activities. To enforce this regime a planning tool is used. After the plan has been constructed it is not directly visible in the interface, i.e. the patient has to click on the 'clock' icon to read his or her planning. The complexity of a plan and the planning tool made it impossible to show the results on the screen continuously. Also note that a plan is fixed. That is, after the patient has made it, and saved it, it cannot be changed anymore by the patient. If the patient gets behind on the schedule the interface will show this to the counsellor by placing the 'late' icon in the overview screen (figure 2). The patient on the other hand receives a standard text message in the case of being late.

Finally, note that the icons in the patient's interface are considerable larger then those in the counsellor's interface (compare figure 1 and 2). The main reason for the latter being smaller was lack of space. However, the idea was that for the counsellor this should not pose any problems. The counsellor spends more time working with the INTERAPIE system and is also more experienced with the set of activities within the treatment. Moreover, in the actual system the icons can be 'read' easily in the counsellor's interface.

The website of INTERAPIE was implemented using Macintosh computers. The webserver of INTERAPIE is WebStar. All the information that is used by the INTERAPIE system is stored in the relational database Butler. The interface of INTERAPIE is written in Tango. Tango is a program that communicates between the database Butler and by doing so can dynamically create HTML pages which can be sent to the webserver WebStar, and thus be made available for the outside world. For example, when a patient wants to see/read a previously written text, he or she has to click on the essay icon. This selection is presented to Tango by Webstar. Tango generates an SQL-query for Butler. As soon as Tango receives a reply from Butler it constructs a HTML page and presents this page to Webstar. Webstar puts the page on the patient's computer screen.

A difficult problem was the use of the many icons and the dynamic way in which each screen had to be constructed using a continuously changing set of these icons. Care had to be taken that the INTERAPIE system didn't take too long to put the next WWW page on the screen.

4. Experiment and Evaluation

Two experiments have been carried out. At the department of Clinical Psychology a rather large experiment has been conducted investigating the effectiveness of the treatment via the WWW. This experiment uses 24 patients and 4 counsellors. Next to this, we have conducting an experiment that investigates the functionality of the INTERAPIE system. We wanted to find out whether users encounter any problems and whether they understand the icon-language that the system 'speaks'. In general, we wanted to investigate how well the system functions as a communication mediator between the patient and the counsellor. The following situations have been investigated: patients with high degree of computer experience (2 persons), patients with low degree of computer experience (2 persons), counsellors who participated in developing INTERAPIE (2 persons), and counsellors who have no experience with INTERAPIE whatsoever (2 persons). We wanted to investigate whether experienced and inexperienced users were able to use the INTERAPIE system. Notice that each of these situations can be investigated independently from the other party, i.e. for an inexperienced patient it does not matter whether he or she is being counselled by an experienced or inexperienced counsellor. The only aspects the patient 'sees' from the counsellor are the written texts that make up instructions and feedback. This is of course independent from issues concerned with the use of the system by the patient. The same is true for the other cases.

The experiment consisted of video-taping users while using the INTERAPIE system. The camera recorded the computer screen showing the interface and the sound (spoken words) made by the user. Users were asked to comment on the system as much as possible. Particularly, they were asked to mentioned unexpected phenomena, issues that confused them or they didn't understand, and things they thought were interesting or good. Next to video-taping, users were asked questions after a single INTERAPIE session (for instance, after writing feedback). Not all sessions were recorded completely, selections were made of periods of which we thought that the use of the system was most critical. For instance, when making the first planning, or reading the first feedback. In contrast, writing the 5th essay will probably not present much new insights on using the INTERAPIE system. However, during all sessions an observer was present to take notice of important events happening.

Some interesting results can be pointed out. Even though the INTERAPIE system had been tested before starting the above mentioned evaluations, some bugs still emerged during some of the sessions. One example was a limit on the number of characters that a certain variable in the program could manage. It turned out that the first instruction written by the counsellors had to be smaller that 200 words. The error was noticed only after the first 'large' message was written by one of the counsellors. Fortunately, the error could be repaired before the first patient wrote an essay. Particularly for the patients, who encounter a program error, this is a

strange and sometimes frustrating event. Imagine the situation in which a patient has been writing an essay for almost an hour and now the machine does not want to store the text. This can be very frustrating for patients.

For inexperienced patients there are many standard computer interface issues that are unclear. If someone has never used a computer, things such as a scroll-bar, a hyperlink, etc. are not so obvious. If you haven't worked with the WWW before and you do not know that sometimes it takes a while for the files to appear on your screen, you may get confused. In some case this resulted in repeatedly clicking on some icons (which made the problem only worse). It was in this respect remarkable to notice that the general help pages were almost never consulted by the patients. This may indicate that the system was still easy to understand and use for them.

The counsellors complained that while constructing a feedback or an instruction they had insufficient overview of general facts about the patient. For example, the age of a patient cannot be assessed by the counsellor while constructing a feedback or an instruction. Although this information is available in the INTERAPIE database, the counsellor can 'only' see/read the essays written by the patient. Counsellors also would like to have a kind of patient specific notebook for making statements about the patient. During the treatment the counsellors want to use this as an external memory on how they are interacting with a patient.

Each time a new patient enters the INTERAPIE system, he or she is assigned to a counsellor. In the current version of the INTERAPIE system each counsellor can get 6 patients at the most. If at some point patient 'number 25' tries to enter the system he or she is not accepted. In the current version of the system this means that the patient receives a message saying that the system is full. In future implementations a kind of waiting room should be constructed in which patients can wait a few days (or weeks) until counselling space is available.

5. Discussion and concluding remarks

While writing this paper the evaluation of the INTERAPIE system is underway, hence our results are preliminary. Still some distinctive points emerge. First, there are errors in the program, or the supporting software, that occasionally hampered users to use the system as planned. Two lessons can be learned from these. The first is the impact of an error. When the system becomes unusable the situation easily runs out of control. Because the system doesn't work it is impossible to inform the patients about what is going on. Consequently, patients cannot access the program and may become uninterested or emotionally more disturbed. The latter problem should not be underestimated although it depends on the problems and the specific therapeutic phase a patient is going through. The second lesson that can be learned concerns the importance of realistic testing during the initial evaluation phase. For example, when we were testing the system with 'test' users, they only typed a few words instead of the lengthy pages as written by real patients. Thus, we never discovered the problem of the system not allowing to type more then 200 words in one message. However, testing is a problem for task-based applications on the WWW involving many users. It is even more of a problem when the interaction lasts for several months and is continuously changing during this period. It is not self-evident how such interactive situations can be 'speed up' for evaluation purposes while not overlooking important details. In our specific case, system breakdown was less a problem for counsellors, because they were fewer in number and could be informed using a phone.

Although the INTERAPIE system has continuously been debugged during the evaluation phases, and at this moment may seem 'to be without many problems', this doesn't mean that in the end the above problem has been solved. There may always be some reason for the required interaction between the patient and the counsellor to be hampered. What do to if someone falls ill? At least some form of meta-communication channel should be available next to the INTERAPIE system to inform users about the meta-problems with the system or related issues that effect them.

Related to the above issue is the need for having a kind of super user (cf. UNIX operating system) to manipulate the contents of the database if required. Due to different kinds of circumstances small modifications had to be made to the database entries that the INTERAPIE system uses. For instance, re-allocating a patient to a different counsellor, or modifying the writing schedule of the patient. In the current version of the system changing something in the database that is outside of the scope of the counselling protocol requires detailed knowledge on how the system has been programmed and can thus only be performed by the system programmer. In a future implementation of the system a super-user facility should overcome this problem.

Next to simply improving the current version of the system, plans have been discussed for a larger INTERAPIE system that might work within a city, nation or maybe even on a world scale. Of course, this would require solving many new problems. Language problems may not even be the most complicated ones. Another plan for future work concerns the construction of 'INTERAPIE-like' systems for other psychological or medical problems that can be treated using a largely fixed protocol as in the case for the treatment of traumatic or stressful life events.

6. References

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Web-Specific Genre Visualization

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Abstract: User interfaces to WWW search engines typically present results as ranked lists of documents. Such lists give users little help in understanding document variation: we propose a richer representation of retrieval results in the search interface. Fundamental to us is the notion of document grouping. We use both stylistic genre-based document categorization and statistical content-based clustering, and organize documents along these criteria in a highly interactive visualization front-end to WWW search engines, enabling quick overview and incremental query refinement.

Introduction

The vast majority of user interfaces to WWW search engines are still based on an exceedingly simple interaction model where a linear list of hits, i.e. document items, is sorted after so-called "relevance" with inner workings and metrics hidden and all but incomprehensible to most users: "This is appealing in its simplicity, but users are often frustrated as they do not know what the results mean, nor can they control aspects of the search." [Shneiderman 1997] Usage problems stem partly from lack of overview and means of

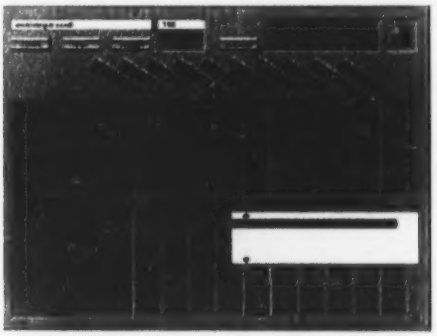

Figure 1: The Easify search interface.

INFORMAL, PRIVATE
PUBLIC, COMMERCIAL
JOURNALISTIC MATERIALS
REPORTS
OTHER TEXTS
INTERACTIVE PAGES
DISCUSSIONS
LINK COLLECTIONS
FAQS
OTHER LISTINGS AND TABLES

Figure 2: The genre palette.

organizing the presentation of documents. These issues are addressed in a user interface framework known as Easify [Fig. 1].

Documents can be grouped by topic as shown by Scatter/Gather [Cutting et al. 1992] or a variety of other criteria, such as site address, geographical location or title similarity. In the framework presented here, the notion of genre or stylistic variation is one of two main grouping criteria. Easify takes genre classification further than other similar tools by establishing a genre palette tailored to the typology of WWW documents, and applying automatic document classification algorithms accordingly. The second dimension made use of in our interface is statistical content-based clustering. Incremental refinement of the search process is supported by means of giving users increased control over pruning the search space through direct manipulation. Envision [Nowell et al. 1997] is another example of a search interface relying on multi-dimensional document visualization.

Stylistic Genre Classification vs. Content-Based Clustering

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Stylistic items can be found on any level of linguistic abstraction: lexical, syntactic, or textual; each is of little import in itself, but taken together their variation indicates systematic differences [Biber 1989, Karlgren 1998]. We make use of dozens of items to classify documents into genres: sets of documents with a consistent tendency to make the same stylistic choices. Useful genres must be based on differences known and recognized by readers. To this end, we have created a genre palette and collected a test corpus tailored for our trial users and the WWW. We have interviewed 102 users on their perceptions of what types of material they find and interact with on-line. These impressions are used to define a palette of genres [Fig. 2] both reasonably consistent with what users expect and conveniently computable using measures of stylistic variation [Dewe et al., 1998]. Our test corpus was used to train a categorization tool. A relatively large number of textual features are calculated for each individual text and combined into simple if-then categorization rules using the C4.5 machine learning tool set [Quinlan 1993]. The features we use here are rather lexical in nature, for ease of processing: the relative frequency of certain classes of words such as personal pronouns, emphatic expressions, downtoning expressions, etc. We add more general textual and genre-specific features: relative number of digits, or average word length, for instance. Others yet are vectored specifically to the web material we have been using for training: number of images or proportion of HREF links in the document, among others. The genre determination algorithm in its current state makes sub-optimal classifications too often. Flexible genre determination would help here – a document should be allowed to fall into several genres rather than exclusively one.

Grouping of documents based on textual content, as opposed to style, is based on traditional statistical term-frequency based metrics. Since the emphasis is on a high degree of interactivity, a quick and rudimentary clustering must be used for the initial document sets. We assume that a small number of clusters in the interface is desirable. Initial clustering can be achieved by defining the first clusters on a few (10-50) randomly selected documents. The clustering itself is a variant of the standard metric: a hierarchical agglomerative group-average algorithm [Jain & Dubes 1988]. After deciding the first n clusters (with n user-adjustable) the following documents are each routed to one of them. A simple assign-to-nearest algorithm is used to decide cluster membership. Cluster headings are currently sets of significant keywords, and could definitely be improved upon.

Visualization of the Document Space

Following query submission, documents found relevant by the underlying search engine are sorted into nm slots, where n is the user-defined number of content-based clusters and m is the system-defined number of genres (currently m=10, following the results of the genre survey and viable screen real estate usage). The group of documents in a slot is presented in the shape of a "bubble" growing as search results become available. Although the number of slots may well be in the range of 30-90, the complexity of navigation is reduced through the clear two-dimensional lay-out with genre headings spelled out along the x-axis and content clusters along the y-axis (Fig. 1). When the cursor is moved across a bubble, a pop-up window is displayed with a list of all the documents contained within the group. This list can be presented using title, URL, size, date and other attributes. Clicking on a single document brings up the abstract, and double-clicking sends the URL to the default web browser to be displayed in its entirety. In order to "zoom in" on a subset of the resulting documents, bubbles can be dragged onto the "regroup" area in the top right corner of the main screen. When regrouping is applied, a second screen appears where only the documents contained in the selected groups are candidates for creating new bubbles. In the subselection, distribution according to genre remains the same as in the superset case, but the content-based clusters may differ.

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ACT-R Electronic Bookshelf :

An Adaptive System to Support LearningACT-R on the Web

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Abstract: This paper presents an electronic ACT-R bookshelf, a system which supportslearning ACT-R, a well-known theory in the field of cognitive psychologyover the WWW. ACT-R bookshelf is a collection of electronic books onvarious aspects of ACT-R. The books on ACT-R bookshelf are authored and served on the WWW with InterBook systemwhich makes most of the books on ACT-R shelf adaptive. This paper describes main functionality of the Bookshelf, provides some evaluationdata, and speculates about possible extensions of Bookshelf- likesystems.

1 Introduction

This paper presents an electronic ACT-R bookshelf, a system which supportslearning ACT-R, a well-known theory in the field of cognitive psychology[Anderson 1993; Anderson & Lebiere 1998], over the WWW. ACT-R bookshelf is a collection of electronic books onvarious aspects of ACT-R. The primary role of ACT-R bookshelf is to serveas an 24-hours available information resource for Carnegie Mellon University on-campusstudents taking course "Production System Models of Thought". However ourintention was to build a system which can be used as a resource fordistance learning of ACT-R, as well as an information resource for the international community of cognitivescientists and ACT-R researchers.

A hierarchically structuredelectronic book (EB) is one of the most popular metaphors for representingonline course material. Virtually any kind of course material can be represented as an electronic book. Currently, thebookshelf contains an ACT-R tutorial, ACT-R 4.0 User Manual, a Manual forACT-R Lisp-based environment, and an ACT-R Glossary. These books are quitedifferent. The ACT-R tutorial is a kind of electronic textbook. It provides a step-by-step introduction intoACT-R theory and ACT-R modeling. The presentation is linearly sequenced andaugmented with multiple examples, quizzes and assignments. ACT-R 4.0 UserManual is an encyclopedia-like book for reference access.

The books on ACT-R bookshelf are authored and served on the WWW withInterBook system [Brusilovsky, Eklund & Schwarz 1998]. Unlike most existing electronic textbooks which are not more than astatic electronic copy of a regular textbook: chapter by chapter, page bypage, picture by picture) most of the books on ACT-R shelf are adaptive.Adaptivity is especially important foreducational programs on WWW which are expected to be used by very differentclasses of students without assistance of a real teacher (who usually can provide adaptivity in a normalclassroom). An adaptive nature of ACT-R bookshelf is based on a specificconcept-based approach suggested originally in [Brusilovsky 1995] and further elaborated by the ELM research group in the process ofdevelopment an adaptive Web-based LISP textbook ELM-ART [Brusilovsky,Schwarz & Weber 1996]. InterBook is the first authoring system whichimplements this approach.

This paper uncovers concept-based knowledge representation behind adaptive electronic textbooks on the Bookshelf, describes mainfunctionality of the system, provides some evaluation data, and speculatesabout possible extensions of Bookshelf-like systems.

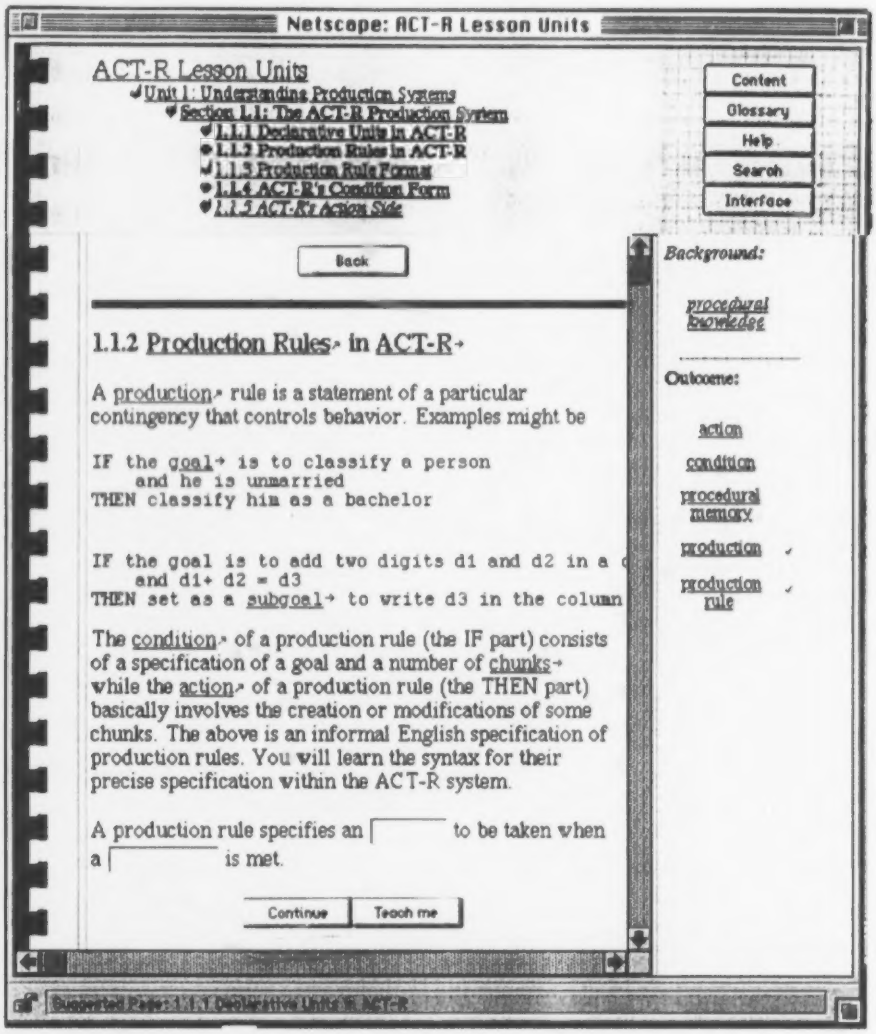
Netscape: ACT-R Lesson Units
ACT-R Lesson Units
Unit 1: Understanding Production Systems
Section 1.1: The ACT-R Production System
1.1.1 Declarative Units in ACT-R
1.1.2 Production Rules in ACT-R
1.1.3 Production Rule Forms
1.1.4 ACT-R's Condition Form
1.1.5 ACT-R's Action Side
Content
Glossary
Help
Search
Interface
Back
Background:
procedural knowledge
1.1.2 Production Rules in ACT-R
A production rule is a statement of a particular contingency that controls behavior. Examples might be
IF the goal is to classify a person
and he is unmarried
THEN classify him as a bachelor
IF the goal is to add two digits d1 and d2 in a
and d1+ d2 = d3
THEN set as a subgoal to write d3 in the column
The condition of a production rule (the IF part) consists of a specification of a goal and a number of chunks while the action of a production rule (the THEN part) basically involves the creation or modifications of some chunks. The above is an informal English specification of production rules. You will learn the syntax for their precise specification within the ACT-R system.
A production rule specifies an to be taken when a is met.
Continue
Teach me
Outcome:
action
condition
procedural memory
production
production rule

Figure 1: A section of ACT-R course material with a quiz as it is presented byNetscape browser. The Concept bar (right) shows outcome and backgroundconcepts for the section. The Navigation center (top) let the user move inone click to any section on the same or upper level. Colored balls (up) and checkmarks (right, on the concept bar)provide adaptive annotation. The button "Teach me" provides directguidance.

2. Knowledge Representation andContent Structuring for Adaptive EB

The key to adaptivity in an adaptive textbook is knowledge about its domain(i.e., ACT-R) represented in the form of domain model and knowledge aboutindividual students represented in the form of individual student models.The domain model serves as a basis for structuring the content of an adaptive EB. We distinguish twocontent parts in each adaptive EB: a *glossary* and a *textbook* . This section provides some minimal

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information about knowledgerepresentation and content structuring. Some more information could befound in [Brusilovsky, Eklund & Schwarz 1998].

ACT-R bookshelf uses the simplestform of *domain model:* a set of domain concepts. By concepts we mean elementary pieces ofknowledge for the given domain identified by a domain expert. The domainmodel provides a structure for an overlay *student model* which is arepresentationof the student's knowledge of the subject. For each domain model concept,an individual student's knowledge model stores some value which is anestimation of the student knowledge level of this concept. For ACT-R domainwe distinguish for states of student knowledge of any concept: "unknown", "known" (learning started),"learned" and "well-learned".

An electronic textbook is a regular book represented in hypermediaform. In InterBook, each EB is hierarchically structured into units ofdifferent level: chapters, sections, and subsections. To make EB "more intelligent" and toconnect it to the glossary, we have to let the system know what each unitof the textbook is about. It is done by indexing of textbook units withdomain model concepts. Several books on the same subject form a bookshelf. All books from the same bookshelf areindexed with the same set of domain model concepts. Each terminal unit hasan attached list of related concepts (we call this list spectrum of theunit). For each involved concept, the spectrum represents the name and the role of the concept in the unit(each concept can be either a outcome concept or a prerequisite concept).The system has an option to show all outcome and background concepts forthe current section on a page borderto the right of the section content (Figure 1)

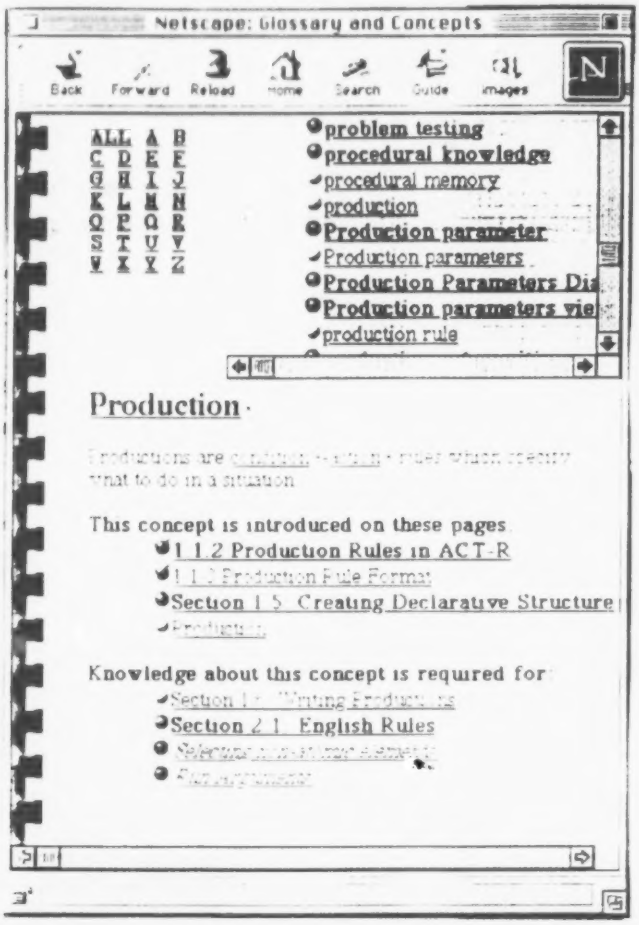

Figure 2: A glossary window showing a "page" for *production.*In addition to providing a description of a concept, each glossary entryprovides links to all book sections which introduce or require the concept. Colored and checked balls to the left of the links and the font typeof the link text provide adaptive annotation.

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The Glossary is, in fact, a visualized domain network. Each node of the domain networkis represented by a node of the hyperspace, while the links between domainnetwork nodes constitute main paths between hyperspace nodes. The linksbetween domain model concepts constitute navigation paths between glossary entries. Thus, the structure of theglossary resembles the pedagogic structure of the domain knowledge. In addition to providing a description of a concept,each glossary entry provides links to all book sections which introduce orrequire the concept (Figure 2). This means that the glossary integratestraditional features of an indexand a glossary.

3. Functionality

Domain model-based indexing is a relatively simple but powerful mechanism,because it provides the system with knowledge about the content of itspages: the system knows which concepts are presented on each page and which concepts have to be learned before starting to learn each page. It opensthe path for several adaptation techniques presented in thissubsection.

3.1. Advanced Navigation

The knowledge about the domain and about the textbook content is used toserve a well-structured hyperspace. As any well-designed EB, the systemsupports sequential and hierarchical links for navigation:

- Each page has*back* and *continue*. links which let the user go though thematerial by a linear way
- The system generates the table of content where all entriesare clickable links to respective sections
- Each page provides *navigation center* on the top for one-click navigation to any section onthe same or upper level and for understanding "where I am" in thehyperspace.

In addition the system uses knowledge aboutthe concepts behind the pages to generate other types of links between theglossary and the textbook.:

- The conceptbar provides links from each textbook page to corresponding glossary pagesfor each involved concept (Figure 1)
- The system identifies concept names in the text and turns theminto hyperlinks to the corresponding glossary pages (Figure 1)
- From each glossary page describing a concept the systemprovides links to all textbook units which can be used to learn thisconcept (Figure 2).

All these links are not stored in an external format but generatedon-the-fly by a special module which takes into account the student'scurrent state of knowledge represented by the student model. This approachis not only reducing page design time but also provides room for adaptation. In particular,our approach supports two adaptation techniques: adaptive navigationsupport and prerequisite-based help.

3.2. Student Modeling,Adaptive Navigation Support, and Adaptive Guidance

The InterBook approach provides many more opportunities for browsing thecourse materials than traditional on-line textbooks. The negative side ofthis is that there is a higher risk for the student to get lost in thiscomplex hyperspace. To support the student navigating through the course, the system uses adaptive annotationand direct guidance technologies. Adaptive annotation means that the systemuses visual cues (icons, fonts, colors) to show the type and theeducational state of each link. Direct guidance means that the system can suggest to the student the next part of thematerial to be learned.

The key to all adaptivefunctionality of ACT-R bookshelf is student modeling. The system maintainsan up-to-date model of individual student knowledge on the subject. The student modeling mechanism accepts two kinds of evidencesof student knowledge of a concept:

- a student havevisited a page which presents some information about a concept (i.e., thepage has this concept among outcome concepts)
- a student answer correctly toa test which checks the knowledge of this concept

The latter evidence is stronger, so no"well-learned" grade can be given to a concept unless the student confirmshis or her knowledge by answering a test.

Using the student model, it is possible to distinguish several educational states for each unit ofEB: the content of a unit can be known to the student (all outcome conceptshave been already learned), ready to be learned, or not ready to be learned(the latter example means thatsome prerequisite knowledge is not yet learned). The icon and the font ofeach link presented to the student are computed dynamically from theindividual student model. They always inform the student about the type andthe educational state of the unit behind the link. In InterBook, red means not ready to be learned, green meansready and recommended, and white means no new information. A checkmark isadded for already visited units (Figures 1 and 2). The same mechanism canbe used to distinguish and show several levels of students knowledge of the concepts shown on the conceptbar. In InterBook, no annotation means "unknown", a small checkmark means"known" (learning started), a medium checkmark means "learned" and a bigcheckmark means "well-learned" (Figure 1). For many students, adaptive guidance provides enough support to makea navigation decision. Those who hesitate to make a choice could push thebutton "Teach me" and the system will apply several heuristics to select the most suitablenode among those ready to be learned.

3.3. Prerequisite-BasedHelp

The system knowledge about the course material comprises knowledge aboutwhat the prerequisite concepts are for any unit of the textbook. Often,when students have problems with understanding some explanation or example or solving a problem, the reason is that someprerequisite material is not understood well. In that case they can requestprerequisite-based help (using a special button) and, as an answer to help request, the systemgenerate a list of links to all sections which present some informationabout background concepts of the current section. This list is adaptivelysorted according to the student'sknowledge represented in the student model: more "helpful" sections arelisted first. Here "helpful" means how informative the section is to learn about the backgroundconcepts. For example, the section which presents information about anunknown background concept is more informative than a section presentinginformation about a known concept. Thesection which presents information about two unknown background concepts ismore informative than a section presenting information about one concept.

4. Evaluation

By the Summer 1998 three groups of students (one group of 10 to 20 studentsper semester) learning ACT-R have been using the ACT-R Bookshelf as a learningresource. Most of the students were undergraduate or graduate Psychologystudents. At the first lecture of the course each group of students has 30to 45 minutes introduction to ACT-R Bookshelf and its functionality. The Bookshelf was a primary source of learninginformation in addition to regular lectures. No printed handouts wereprovided.

It was our intention to evaluatehow useful are the advanced features of the Bookshelf for Psychology students. Our standard evaluation technology in InterBook is comparingperformance of InterBook users with a performance of a control group whichuses a system with advanced functionality disabled [Brusilovsky & Eklund1998]. Unfortunately, the number of students taking the ACT-R course is toosmall to run a control group. Instead, we have used a more subjectiveevaluation technology - a specially developed questionnaire. The goal ofthe questionnaire (41 questions in total)was to check whether the users understand the advanced functionality of the system (13 questions),whether they find it useful (24 questions), and what kind of improvementsthey could suggest (4 questions). We have run the questionnaire with one ofthe groups and collected 11 correctly filled forms. Due to the lack of space we could report only some mostinteresting results here.

Our major concern was that Psychology students will not be able tounderstand the advanced functionality of the Bookshelf even after a 30-45minutes introduction. To check it we have developed 13 special questions to test theirunderstanding. The results show that adaptive navigation support, the most"intelligent" functionality of the Bookshelf, is quite clear to thestudents. 11 or 11 students understand the role of the "green ball" and 10 of 11 understand the role of "red ball"and "checked ball". To compare with , less than half of students were ableto understand the functionality of "Search" button, which provides standardsearch functionality (a featureof any advanced Web site). At the same time, the students have notconsidered adaptive navigation support as a very useful feature. Variouscomponents of it were rated 2.5 to 3.1 on a scale where 1 means totallyuseless and 6 means very useful. Here we should agree with the students. Adaptive navigation support is not very usefulfor well-organized sequentially read textbooks like the ACT-R textbook(here the best strategy is just read all units

one after another). Adaptivenavigation support was designed primarily for the users who need to learn selected parts of the ACT-Rmaterial and need to use "backward learning" to meet all prerequisites.

5. Prospects for ACT-RBookshelf as a Integrated Resource on the WWW

A concept-based indexing of EB on ACT-R bookshelf provide a uniqueopportunity of concept-based linking of various kinds of ACT-R relatedinformation. As soon as the ACT-R domain model (a consistent andcomprehensive set of ACT-R concepts) is created andall book on the shelf are indexed with ACT-R concepts, these books are invisibly linked through the glossary. Eachpage of any book which is indexed with a concept will have a link to aglossary entry for this concept. In turn, a glossary entry for a conceptwill include the links to all pages in all books on the shelf which are indexed with this concept. Currently, thebookshelf contains primary the tutorial and manual-like books. However, weconsider several useful extensions of the bookshelf.

- ACT-R addressbook may list researchers working in ACT-R area providing at least annotated links to their home pages. A page inan address book may be indexed with concepts showing area of interest ofthis particular researcher within ACT-R domain.
- An annotated collection of ACT-R research papers may provide a number ofexisting papers on-line. Each page in this book may provide an abstract anda URL for one particular paper. This page may be indexed with the conceptsdiscussed in this paper as well as with a set of prerequisite concepts required to understand it. Somepapers may be represented on a bookshelf as separate books. In this caseeach section of the paper may be indexed.
- The content of main ACT-R book may be indexed section by section and placedon the WWW as a virtual copy of the book. When for the copyright reasonsthe content could not be placed on the WWW, the page range in the actualbook may be provided enabling auser easy fine a require place in the book.

There are multiple outcomes of having allACT-R resources on a single bookshelf interconnected by a global glossary as presented above. Wherever the userstarts, he or she can see the concepts behind the pages and see a glossaryentry for any of these concepts. A glossary entry for a concept willprovide links to all relevant information which exists on the bookshelf. For a introductory-level concept, the userwill be able to see book, tutorial or manual pages explaining this concept.For more advanced concepts, the user will also see a list of papers dealingwith this concept and a listof people investigating this concept deeply. We hope that such anintegrated bookshelf accessible worldwide will seriously contribute for thepromotion of ACT-R learning and research worldwide.

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Anticipating Information Needs: Everyday Applications as Interfaces to Internet Information Resources

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Abstract: We outline work on a class of systems called *Personal Information Management Assistants* (PIMAs). PIMAs observe user interaction with everyday applications, and use these observations to anticipate a user's information needs. They then automatically fulfill these needs by accessing Internet information sources, filtering the results, and presenting them to the user. Essentially, they allow everyday applications to serve as interfaces for traditional information retrieval systems. In this paper, we present our preliminary work on an architecture for this class of systems, and our progress implementing such a system. Finally, we discuss our preliminary results and survey directions for future work.

1. Motivation and Introduction

In recent years, we have experienced an explosion in the amount of information available online. Unfortunately, tools that allow users to access this information are still rudimentary. Users are often forced to express their information needs in Boolean query languages, or fill out a complicated form. More, systems often offer results that are unnecessarily redundant and poor in quality—partly because the user is unable to specify his needs in terms of a query well enough, and partly because of the nature of the software servicing his query. Some intelligent systems allow users to pose their information needs in the form of a question [Burke, et al., 1997] [Kulyukin, et al., 1998]. Others allow users to search by example [Hammond, et al., 1994]. Nonetheless, these kinds of systems still require the user to make his information needs explicit to the system. Thus, while Internet search engines provide a first step at solving this information access problem, most of them not only fail to produce good results reliably, but are also hard to use. Systems that answer questions or allow users to search by example provide a solution to part of this problem, yet remain inconvenient.

In response to the problems posed by the current state of information retrieval systems, we are working on a class of systems we call *Personal Information Management Assistants* (PIMAs). PIMAs observe user interaction with everyday applications, and use these observations to anticipate a user's information needs. They then automatically fulfill these needs by accessing traditional information retrieval systems (e.g., Internet search engines), filtering the results, and presenting them to the user. Essentially, they allow everyday applications to serve as interfaces for traditional information systems, paving the way for us to remove the notion of query from information systems altogether.

In this paper, we present our preliminary work on an architecture for this class of systems, and our progress implementing such a system. Finally, we discuss our preliminary results and survey directions for future work.

2. Overview and Architecture

One of the main insights driving our work is that information-seeking behavior, such as posing a query to a search engine, is *goal-directed* behavior. In this view, posing a query to a search engine is a step in a plan that satisfies the goal of finding information about a certain topic. Given that finding information is usually in service of some goal, we can construct a library of *information-consumption scripts* (using "script" in the sense of [Schank & Abelson, 1977]) associated with satisfying a user's goals. Scripts are knowledge structures that house information about highly routine situations. In an appropriate context, they serve the purpose of making strong predictions about situations and sequences of events. For a PIMA, knowledge of a user's information-consumption scripts means the ability to anticipate information-seeking goals and the ability to automatically fulfill them.

The second observation we bring to this problem allows us to readily apply the above understanding technique. The observation is that standard information systems, the documents themselves, and the environments in which they are produced, consumed, and otherwise manipulated are highly structured and regular. To mention just a few of these regularities:

1. Within the document, gross structures such as headings, paragraphs, and titles are prevalent and have a well-known semantics.
2. Documents have a gross morphological form (e.g., letter, newspaper article, invitation, memo, etc.), that corresponds directly to the document's function.
3. Everyday computer applications serve a particular and easily attributable function.
4. Everyday computer applications have well-formed interaction semantics.
5. Information retrieval systems have an interface that is arguably easier for a computer to use than a human.
6. Information retrieval systems are computer programs that generate regular output.

The above structure and regularity, as well as the semantics associated with the regularity of this world make it particularly amiable for a computer program. This is not all that surprising—after all, the environment, in fact, *is* a collection of computer programs. What is interesting, however, is that because this particular part of the world is so strongly structured, human behavior within it is also highly structured and regular. It follows that this regularity in the environment (in terms of computer programs, documents, and information systems) and in user behavior should be known and used by a PIMA to inform the task of understanding that behavior.

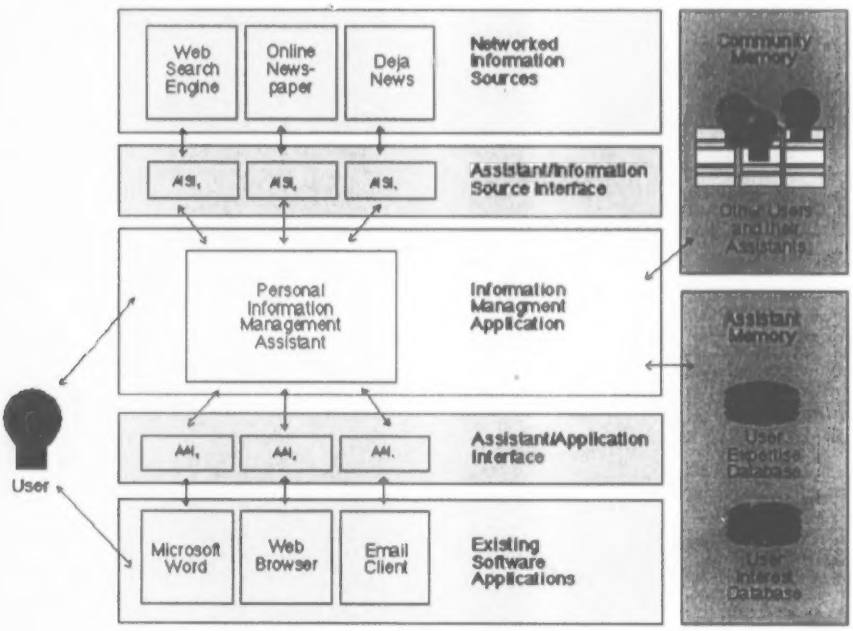

Figure 1: PIMA Architecture

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We have built a prototype PIMA that observes user interaction with everyday applications (e.g., Netscape Navigator, Microsoft Internet Explorer, and Microsoft Word), and, using a very preliminary knowledge of information-consumption scripts, is able to anticipate a user's information needs. It then attempts to automatically fulfill them using common Internet information resources.

Given the requirements that it must observe several applications and that it must also use multiple information resources, we have adopted the five-tiered architecture depicted in [Fig. 1]. The user interacts with their everyday applications (shown at the bottom of the diagram), and the information management application in the middle. Through a series of adapters, the assistant application communicates with the existing software applications through the operating system's IPC facilities. The assistant then interprets user behavior in these applications, and constructs a query, which it sends off to information sources at the top. It collects the results, and applies information-filtering heuristics that allow it to present the user a concise, high-quality list of suggestions. These suggestions are presented in a window for the user to browse. Eventually, we plan to give our PIMA a memory of user interests and expertise (c.f. [Budzik & Hammond, 1998]), as well as the ability to communicate with other users' assistants, in order to personalize and improve the quality of the results.

3. Implementation

Currently, our PIMA observes user interaction in unmodified versions of Microsoft Internet Explorer and Microsoft Word, as well as a modified version of Mozilla (Netscape's free-source version of Navigator). The PIMA communicates with Microsoft Word and Internet Explorer through COM (PC only), and with Mozilla through BSD sockets (UNIX and PC). We designed our architecture with the idea that application interfaces should be the only OS-dependent components. We implemented the assistant application in Java, for maximum portability and ease of development. These design decisions afford us the ability to extend the PIMAs field of observation relatively easily, without having to change the core application code.

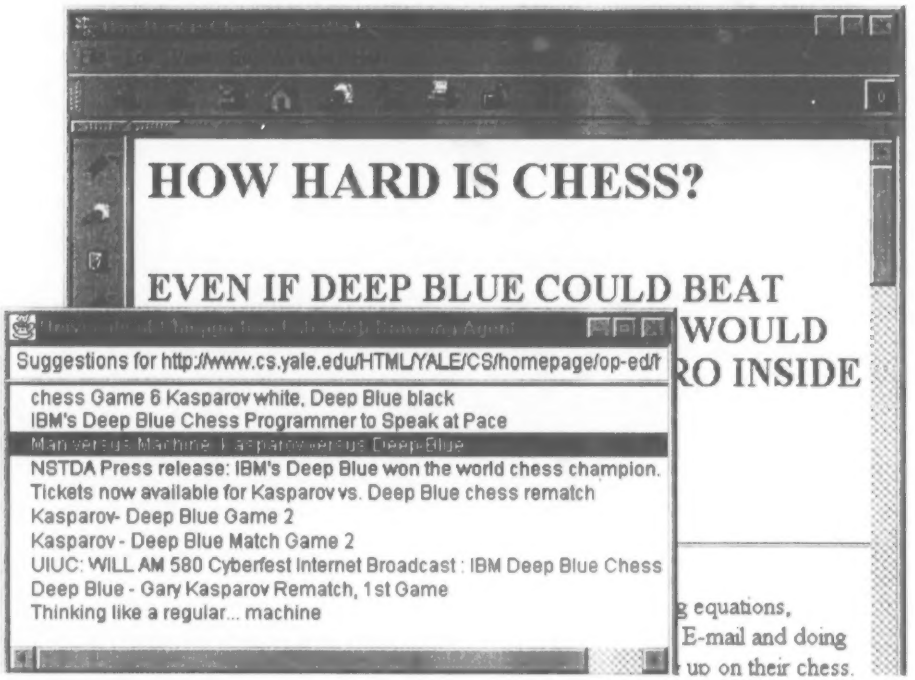
HOW HARD IS CHESS?
EVEN IF DEEP BLUE COULD BEAT
WOULD
RO INSIDE
Suggestions for http://www.cs.yale.edu/HTML/YALE/CS/homepage/op-ed/f
chess Game 6 Kasparov white, Deep Blue black
IBM's Deep Blue Chess Programmer to Speak at Pace
NSTDA Press release: IBM's Deep Blue won the world chess champion.
Tickets now available for Kasparov vs. Deep Blue chess rematch
Kasparov- Deep Blue Game 2
Kasparov - Deep Blue Match Game 2
UIUC: WILL AM 580 Cyberfest Internet Broadcast : IBM Deep Blue Chess
Deep Blue - Gary Kasparov Rematch, 1st Game
Thinking like a regular... machine
g equations,
E-mail and doing
up on their chess.

Figure 2: Suggesting Relevant Web Pages

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3.1 Finding Relevant Pages

The simplest of the information-consumption scripts we have identified is associated with finding related web pages. The FIND-RELATED-PAGES script is composed of the following basic steps.

1. Summarize the document in terms of a few words.
2. Pose a query to a search engine using these words.
3. Sift through the results, searching for ones that are actually related.

It is applied when the assistant anticipates the user wants more information in the subject area of the document he currently manipulating. For the two Web browsers, the PIMA recognizes when a user navigates to a new web site, either by clicking on a link, or by explicitly opening a URL. In Microsoft Word, it recognizes when a user has opened a document or changed it significantly.

There are essentially two processes associated with retrieving relevant documents: query construction and information filtering. [Fig. 2] demonstrates the user interface associated with the result of these two processes applied in sequence.

3.1.1 Query Construction

In order to retrieve relevant sites, the PIMA constructs a query based on the contents of the current web page, and sends it off to AltaVista [1]. To construct a query, the PIMA uses three techniques to decide on which words should be included: a standard stop list and two heuristics for rating the importance of a word.

Sun Speaks Out On Java Standardization	http://www.html.co.nz/ news/110605.htm
Java Standardization	http://aidu.cs.nthu.edu.tw/ java/JavaSoft/www.javasoft.com/aboutJava/standardization
Java Standardization Update – SnapShot	http://www.psgroup.com/snapshot/1997/ss109706.htm
Informal XML API Standardization for Java	http://xml.datachannel.com/ xml/dev/XAPIJ1p0.html
International Organization For Standardization Gives Java The Nod	http://techweb1.web.cerf.net/ wire/news/1997/11/1118java.html
Java Standardization	http://java.sun.com:81/ aboutJava/standardization/index.html
Sun Moves Java Standardization Forward	http://techweb4.web.cerf.net/ wire/news/1997/09/0922standard.html
Java Standardization	http://java.sun.com/aboutJava/standardization/index.html
Java Standardization	http://www.javasoft.com/ aboutJava/standardization/index.html
Informal XML API Standardization for Java	http://www.datachannel.com/xml/dev/Commonality.html
Java Standardization	http://www.intel.se/design/news/javastand.htm
The impact of Java standardization	http://www.idg.net/ new_docids/find/java/suns/standardization/ developers/submitter/approval/ affects/new_docid_9-48305.html
Java Standardization - A Whitepaper	http://java.sun.com/aboutJava/standardization/javastd.html

Table 1: Output of a query generated from a page on Java standardization

[1] http://altavista.digital.com/

Sun Speaks Out On Java Standardization	http://www.html.co.nz/news/110605.htm
Java Standardization	http://aidu.cs.nthu.edu.tw/java/JavaSoft/ www.javasoft.com/aboutJava/standardization/, http://java.sun.com:81/aboutJava/ standardization/index.html, http://java.sun.com/aboutJava/standardization/index.html, http://www.javasoft.com/aboutJava/ standardization/index.html, http://www.intel.se/design/news/javastand.htm, http://www.idg.net/new_docids/find/java/ suns/standardization/developers/submitter/ approval/affects/new_docid_9-48305.html, http://java.sun.com/aboutJava/standardization/javastd.html,
Java Standardization Update - SnapShot	http://www.psgroup.com/snapshot/1997/ss109706.htm,
Informal XML API Standardization for Java	http://xml.datachannel.com/xml/dev/XAPIJ1p0.html, http://www.datachannel.com/xml/dev/Commonality.html,
International Organization For Standardization Gives Java The Nod	http://techweb1.web.cerf.net/wire/news/ 1997/11/1118java.html,
Sun Moves Java Standardization Forward	http://techweb4.web.cerf.net/ wire/news/1997/09/0922standard.html,
change nothing - JavaWorld - October 19	http://www.javaworld.com/javaworld/ jw-10-1997/jw-10-iso.html,

Table 2: Results of clustering responses

The first heuristic is that words at the top of the page tend to be more important than the words at the bottom. The second is words that occur with high frequency (that are not in the stop list) in a document are usually representative of the document. The terms with the top 20 weights form the query that is sent to AltaVista.

3.1.2 Information Filtering

Because the results returned from AltaVista are often redundant, containing copies of the same page or similar pages from the same server, the PIMA must filter the results so as not to *add* to a user's feeling of information overload [Maes, 1994]. If these similarities are not accounted for, some of the more interesting pages returned by AltaVista may be missed. Moreover, we constantly face the risk of annoying the user instead of helping him. As a result, we actively attempt to reduce the amount of irrelevant information presented, and in doing so address some of the problems associated with a constantly updating interfaces (like [Lieberman, 1995]). To this end, we have designed our prototype to collect search engine results and cluster similar pages, displaying a single representative from each cluster for the user to browse.

For this task, we currently use three pieces of information that AltaVista returns for each document: the document's title, its URL, and the date on which it was last modified. For each of these pieces we have a heuristic similarity metric. The similarity of two titles is represented numerically by the percentage of words they share in common; two URLs are compared by examining their host, port and closeness in terms of directory structure; and two dates are judged by the number of days separating them. The combination of these similarity metrics is sufficient to determine the uniqueness of the documents returned.

[Tab. 1] shows a typical response from AltaVista generated by a query posed in response to a page on Java Standardization (we have deleted several long ones for brevity). Notice there are a number of mirror sites, as well as logical duplicates (they may have different URLs, but they are the same file). [Tab. 2]

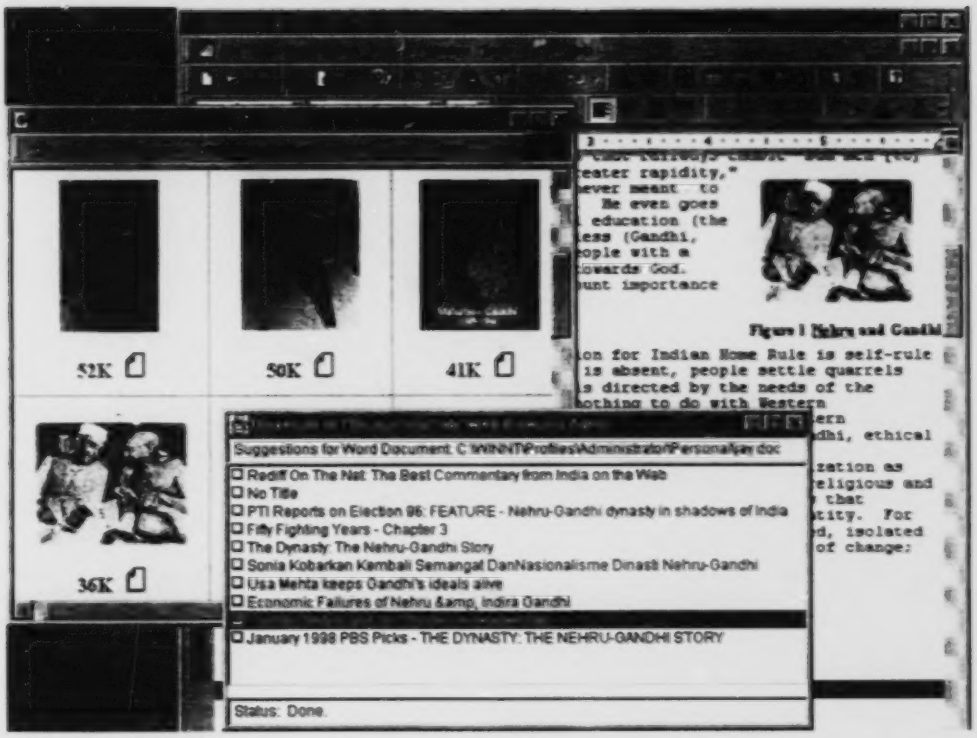
52K
50K
41K
36K
Suggestions for Word Document: C:\WINNT\Profiles\Administrator\Personal\jay.doc
Rediff On The Net: The Best Commentary from India on the Web
No Title
PTI Reports on Election 96: FEATURE - Nehru-Gandhi dynasty in shadows of India
Fifty Fighting Years - Chapter 3
The Dynasty: The Nehru-Gandhi Story
Sonia Kobarkan Kembali Semangat DanNasionalisme Dinasti Nehru-Gandhi
Usa Mehta keeps Gandhi's ideals alive
Economic Failures of Nehru & Indira Gandhi
January 1998 PBS Picks - THE DYNASTY: THE NEHRU-GANDHI STORY
Status: Done

Figure 3: PIMA Prototype - Suggesting Images

shows these URLs after clustering. Instead of presenting the user with 20 sites, we present him with 10, effectively removing the duplicates and mirrors.

3.2 Exploiting Structural Cues: An Example

Of course, the more abstract goal is to find relevant resources, not simply related pages. To demonstrate both the feasibility of extending the domain of resources exploited by our architecture, as well as power of this paradigm of interaction, we have extended the PIMA's functionality in Microsoft Word to include the ability to recognize when a user inserts a caption. The script associated with this situation suggests a different class of information-consumption behaviors we can anticipate: those that are dependent on the structural context of the active document. The FIND-RELATED-IMAGES script is applied when the user has inserted a caption with no image to fill it (and probably others—we make no claims about being exhaustive, here). It contains the following steps:

1. Summarize the desired picture in terms of a few words.
2. Send these words off to an image search engine.
3. Sift through the results and choose the best one.

In response to the above situation, the PIMA applies this script and predicts the user will require an image. It then sends off a query to Arriba Vista [2] a commercial implementation of WebSeer [Frankel, et al., 1997], an image search engine. The PIMA constructs the query using a piece of knowledge about the structure of documents, in general: that the caption of an image is a verbal summary of that image. Hence the query it constructs is simply the conjunction of the stop-listed terms in the caption. The results from the image search are presented in a web browser window, from which the user can drag-and-drop the images into Microsoft Word (see [Fig. 3]).

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[2] http://www.arribavista.com/

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4. Related Work

Software that recommends web pages and learns user preferences has been the intense focus of recent research in Artificial Intelligence and Information Retrieval. A few good examples of related work follow. Letizia [Lieberman, 1995] is an agent that recommends web pages by compiling a profile and doing lookahead search in the locus of the current web page. ParaSite [Spertus, 1998] is a system that suggests relevant web pages using link topology. WebMate [Chen & Sycara, 1998] keeps track of user interests and uses them to extend queries to search engines. Maxims [Lashkari, et al., 1994] learns relationships between application events and user interaction patterns in an email package and uses them to predict and carry out common tasks. The Remembrance Agent [Rhodes & Starner, 1996] suggests related documents you've written as you compose a new document. The Shop Bot [Doorenbos, et al., 1997] queries various commercial sites for price information to aid the user in the task of comparison-shopping. Finally, Alexa [3] is a company dedicated to recommending web pages, and is responsible for the "Find Related Pages" button in the new Netscape Navigator.

Our approach differs from the above and contributes in several important ways:

1. *User behavior modeling.* User behavior is modeled and can be used to inform all of the assistant's tasks.
2. *Search is automatic and distributed.* The goal of finding relevant documents is predicted and carried out automatically using an extensive, dynamic chunk of the web. We do not require a pre-compiled index of related documents—only access to standard web search engines.
3. *Search is directed.* Search is directed and constrained by the content and the structure of the document at hand.
4. *Results are post-processed.* By applying several simple, low-cost web page similarity heuristics we were able to improve the quality of suggestions dramatically.

5. Directions for Future Research

Our initial experiment suggests that the combination our heuristics for query generation and for response clustering produce high quality, on point suggestions. Our hypothesis is that this is due to the fact that the query generation algorithm we apply to documents roughly mirrors the process of document indexing, and that the clustering heuristics are effective. While our initial results are promising, the system has much room for improvement.

Most obviously, our library of scripts is very sparse. Augmenting it so it understands more user/application interactions (and thus is able to anticipate more kinds of information needs) will be of primary concern. Tied to this is the fact that the PIMA has a very rudimentary notion of document structure. As it stands, the query construction algorithm ignores all but the most obvious structure of the documents it uses. Applying heuristics to improve the query construction algorithm based on document structure will not only improve query construction, but it will also afford the assistant the opportunity to direct its search for recommendations based on that structure. Queries frequently include terms that are of little information value to vector space information retrieval systems like AltaVista. Composing a table of term frequencies from a random sample of web documents and using this table to negatively weight terms with very high frequencies will increase the number of "quality" query terms sent to information sources. As a further improvement, we plan on adding support for more information resources and developing a vocabulary for expressing the kind of information available, as well as a means by which the assistant can be made aware of new information resources as well as filter suggestions in a task-directed way.

Finally, our prototype is reactive in the strictest sense—it has no memory, and knows nothing about what the user prefers. Giving our PIMA the ability to learn user preferences and leverage this knowledge as it attempts to anticipate information needs, select appropriate sources, and filter results from those responses is sure to improve the quality of suggestions dramatically. Clearly there is much more to be done.

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[3] http://www.alexa.com/

6. Conclusion

In summary, we have outlined several major problems associated with contemporary information access paradigms. In response, we presented an architecture for a class of systems we call *Personal Information Management Systems*. These systems observe user interactions with everyday applications, anticipate information needs, and automatically fulfill them using Internet information sources. Essentially, they turn everyday applications into intelligent user interfaces for conventional information retrieval systems. We presented our initial work on a prototype of this kind of system, some related work, and closed with directions for future research.

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One Planet, One Net: Principles for the Internet Era

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Abstract:

The emergence of the Internet presents enormous opportunities and challenges to humanity. If we work to preserve its openness and diversity, we can ensure that the Net will be used to change the human condition for the better, and can prevent or mitigate its less desirable consequences.

The Internet is more than wires, computers, software, modems, routers, standards, and the applications that use them. It even encompasses more than text and pictures, and the audio and video that are rapidly joining those media. The Net is also the collective knowledge and experience of countless communities, each with its own modes of interaction, languages of discourse, and forms of cultural expression.

Certain principles must be understood and respected as we consider the more detailed daily questions that arise in the administration or governance of the Net. We believe that among these principles are the following:

1. The Net links us all together.
2. The Net must be open and available to all.
3. Net users have the right to communicate.
4. Net users have the right to privacy.
5. People are the Net's stewards, not its owners.
6. Administration of the Net should be open and inclusive.
7. The Net should reflect human diversity, not homogenize it.

The continuing evolution of the Internet presents both opportunities and challenges. We must work to counter the political, economic, social, and technical forces that work against these principles and threaten the promise of open communication on the Internet. Failure to do so may lead to a future in which the Internet is homogenized, commercialized, and regulated to the extent that it fails to meet its fundamental mission - to serve as a medium for maximizing human potential through communication.

1. The Net links us all together.

The nature of people and their use of networking technology provides a strong natural drive towards universal interconnection. Because the flow of information on the Net transcends national boundaries, any restrictions within a single country may act to limit the freedom of those in other countries as well.

The true value of the Internet is found in people, not in technology. Since each new user increases the value of the Net for all, the potential of the Net will only be reached when all who desire can openly and freely use the Net.

2. The Net must be open and available to all.

The Net should be available to all who wish to use it, regardless of economic, social, political, linguistic, or cultural differences or abilities. We must work to ensure that all people have the access to the technology, education, and support necessary for constructive, active participation. People in all walks of life should have as much right to send and receive information as do the affluent and powerful.

3. Net users have the right to communicate.

Every use of the Net is inherently an exercise of freedom of speech, to be restricted only at great peril to human liberty. The right to communicate includes the right to participate in communication through interacting, organizing, petitioning, mobilizing, assembling, collaborating, buying and selling, sharing, and publishing.
The Net offers great promise as a means of increasing global commerce and collaboration among businesses, but restrictions on information exchange would eviscerate that promise.

4. Net users have the right to privacy.

Without assurances of appropriate privacy, users of the Net will not communicate and participate in a meaningful manner.
The right to privacy includes at least three forms:

Individual Network users should control the collection, use, and dissemination of personal data about themselves, including financial and demographic information.

Network users should be free to use any available technical measures to help ensure the privacy of all aspects of their communications.

Individuals have the right to control who they communicate with, and how they conduct that communication. The privacy implied by the decision to not communicate must be respected.

5. People are the Net's stewards, not its owners.

Those who want to reap the benefits of the shared global Net are obliged to respect the rights of others who may wish to use the Net in different ways. We must work to preserve the free and open nature of the current Internet as a fragile resource that must be enriched and passed on to our children.
Individual pieces of the Net, such as wires, routers, and servers, have owners whose economic rights and interests must be respected. However, just as the ecosystem in which we live cannot be owned, the Net itself is not owned by anyone.

6. Administration of the Net should be open and inclusive.

The Net should be administered in an open, inclusive, and democratic manner for the betterment of humanity.
The needs of all who are affected by the Internet - including current users, future users, and those who are unable to or choose not to be users - must be considered when making technical, social, political, and economic decisions regarding the operations of the Internet.
Although administration of the Net should aim to enhance its efficiency, availability, and security, it should not do so at the cost of discouraging use of the Net. Administration should facilitate and encourage greater use of the Net for communication, rather than inhibit it in any way.

7. The Net should reflect human diversity, not homogenize it.

The Net has the potential to be as varied and multi-cultural as life itself. It can facilitate dialogue between communities and individuals that might previously not have encountered each other in a dozen lifetimes.
However, the Net could also become a homogenizing force, working to suppress diversity in favor of a bland globalism.
Individuals and communities should not be forced to forego local cultures and traditions in order to participate in the Net.
In order to preserve the vitality that comes with a diversity of viewpoints, we should work toward helping the whole world participate as equals.

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Internet Security Incidents, a Survey within Dutch Organisations

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Abstract: This paper presents the main results of a survey held by de Vrije Universiteit Amsterdam and KPMG EDP Auditors, concerning Internet-related security incidents. The survey was held within Dutch organisations that are currently using the Internet. The first aim of the project was to determine the actual security risks of using the Internet. This requires insight in the percentage of companies experiencing Internet-related security incidents, the damage caused by the incidents, the way the affected companies deal with the incidents and a profile of the perpetrators. The second aim of the project was to determine the right security measures in order to prevent security incidents. This was done by (1) analysing the security incidents to find out in which way they could be prevented and (2) trying to find correlations between certain security measures and (the absence of) security incidents.

1. Introduction

As more and more organisations are connecting to the Internet, security is becoming increasingly important. The fact that security is indeed a problem is illustrated by a survey carried out by Dan Farmer, showing that over 60% of 1700 inspected sensitive Websites, such as banks, credit unions, newspapers and government agencies, could be broken into or even destroyed [Farmer 1996].

Given the high number of vulnerable sites, an interesting question is which part of the organisations using the Internet is actually experiencing Internet related security incidents. The existing surveys that tried to answer this question, such as carried out by CERT/CC [Howard 1997] and Prowatch Secure (a commercial security surveillance service) [Prowatch 1997], are usually based upon a special subset of the Internet connected organisations, such as those requesting assistance from CERT/CC or those having their network security surveyed by Prowatch. It is therefore hard to determine to which extent the resulting figures are representative for the Internet as a whole. Furthermore, these surveys also provide little insight in the amount of damage caused by the incidents to the affected organisations.

A second question is what measures should be taken in order to prevent security incidents. Although many measures are being advised for the technical as well as the organisational part of security [Garfinkel & Spafford 1996] [Roos 1996], little is known about the effectiveness of these measures.

2. Definitions

An *incident* is a situation in which the security of a computer system has been violated. This survey focusses on the following kinds of incidents:

- unauthorised access, whereby someone on the Internet gained access to computer systems or information without being authorised to do so;
- denial of service, whereby someone on the Internet managed to disrupt the information services;
- malicious code, such as viruses and Trojan horses, being spread by means of the Internet.

An *attack* is an attempt to cause an incident by trying to identify and/or exploit security vulnerabilities.

A distinction is being made between the Internet site and the internal IT-infrastructure. The *Internet site* consists of the information services (such as WWW of FTP) that are being offered to the Internet. The *internal IT-infrastructure* on the other hand, consists of the information services (possibly including Internet services such as e-mail or Web-access) offered to internal users. The main differences between the Internet site and the internal IT-infrastructure is that the users of the Internet site are located (externally) on the Internet, while the internal IT-infrastructure is being used exclusively by own employees. This also means that the internal IT-infrastructure usually contains the greater part of the business critical information. Therefore, incidents affecting the internal IT-infrastructure can have a higher impact than incidents affecting the Internet site.

3. About the Survey

The survey, a joint project between *de Vrije Universiteit Amsterdam* and *KPMG EDP Auditors*, was carried out by sending enquiries to 878 organisations that are currently using the Internet. The organisations were selected using the DNS information of the *.nl* domain, with a strong preference for organisations that have their own Internet system administration, as the questionnaires were to be filled in by the system administrators.

Eventually, 145 usable responses were received, obtaining a response-rate of approximately 17%. For a sensitive subject like computer security incidents, this is not a bad result. A similar survey, carried out by the *Computer Security Institute* (CSI) in co-operation with the FBI reached a response-rate of 9% [CSI 1996].

4. Characteristics of the Responding Organisations

The responding organisations can be described by the following characteristics:

- both small and large organisations (measured by annual turnover, number of employees and number of IT-administrators) are significantly represented;
- although several sectors are represented among the responding organisations, approximately one third of the population consists of Internet providers and the IT-sector. This is probably caused by the (earlier mentioned) preference for organisations that have their own Internet system administration;
- about one third of the population (99 organisations) has an Internet-site that is maintained by its own personnel. More than half (58%) of the organisations with an Internet site have their site for longer than one year, which is in principle long enough to be confronted with security incidents;
- about one third of the population (98 organisations) has a permanent link between the Internet and their internal IT-infrastructure (often using a firewall);
- the responding companies have serious interests in (the security of) their Internet-facilities because:
    - 53% of the responding organisations with an Internet site uses it as to generate income (at least $ 5.000 on annual base) or to provide their customers with support for delivered products or services;
    - in two third of the organisations where the personnel has one or more Internet facilities at their disposal, one or more facilities (mostly e-mail) were classified as *essential*, meaning that the loss of the facility would result in a immediate loss of productivity;
    - in three out of four organisations more than 75% of the employees have a workplace with computer facilities, which means that a potential security incident can affect a significant part of the organisation.

5. The Extent of the Problem

An estimate of the part of the Internet connected organisations that is attacked is hampered by the fact that organisations do not need to be aware that such attacks took place. The data of [Tab. 1] has therefore been calculated twice: once for all the organisations, regardless whether they have implemented adequate detection measures and once for the organisations that have at least implemented a minimal form of detection (a regular check of the log files). It is felt by the researchers that the latter group, although having a smaller size, provides a more realistic insight into the extent of the problem.

Environment	Percentage of organisations reporting attacks (regardless of detection measures)	Percentage of organisations reporting attacks (organisations with regular log-checks)
Internet site	32% over 18 months (n=99)	45% over 17 months (n=51)
Internal IT-infrastructure	29% over 19 months (n=98)	40% over 20 months (n=47)

Table 1: Percentage of organisations reporting attacks

A similar table can be set up with respect to the incidents (meaning attacks that have broken through the security measures), as done in [Tab. 2].

Environment	Percentage of organisations reporting incidents (regardless of detection measures)	Percentage of organisations reporting incidents (organisations with regular log-checks)
Internet site	12% over 18 months (n=99)	18% over 17 months (n=51)
Internal IT-environment	10% over 19 months (n=98)	9% over 20 months (n=47)

Table 2: Percentage of organisations reporting incidents

The percentages of attacks and incidents for the Internet site are based on organisations having an Internet site which is being maintained by their own personnel. The percentages of attacks and incidents for the internal IT-infrastructure are based on organisations having a permanent link (leased line) between the Internet and their internal IT-infrastructure.

6. Attacked Organisations

The attackers do not seem to be very selective when choosing their targets. The chance of an attack is relatively constant, regardless the size of the organisation or the sector it operates in.

The only exceptions are the media and the non-profit sector. These are reporting more, respectively fewer attacks. A possible explanation is that hacker ethic is to some extent keeping the perpetrators from attacking non-profit organisations (of which most of them, such as humanitarian organisations of the environment activists have an idealistic mission). The media on the other hand are likely to be extra attractive because of their high visibility and the potential amount of publicity a successful attack would generate.

7. Providers and Clients

Organisations	Percentage reporting incidents Internet site
Providers	15% (n=34)
Clients	0% (n=31)

Table 3: Reported incidents by providers and clients

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There is a remarkable difference in incident reports between the Internet providers and the organisations that have outsourced the technical maintenance of their Internet site to a provider. While providers are affected by security incidents concerning their Internet site, the organisations that have outsourced the maintenance of their site do not seem to be aware of it. Although the cause of this situation could not be determined, it is certainly advisable for organisations outsourcing the maintenance of their Internet site, to define clear procedures for reporting incidents in the contract with their provider.

8. A Closer Look at the Security Incidents

In the following paragraphs the incidents concerning unauthorised access, denial of service and malicious code will be dealt with. The number of reported incidents (17, 4 and 9 for unauthorised access, denial of service and malicious code respectively) is, however, not sufficient to do a thorough statistical analysis. The discussion will, therefore, be limited to the most striking trends.

8.1. Unauthorised Access

In seems that in most incidents considering unauthorised access, the impact on the operations of the affected organisation is limited. The number of affected systems is usually one (counting only the affected systems within the surveyed organisation). None of the organisations reported missed revenue, nor did the perpetrator read or modify any business sensitive data such as the personnel database or the financial records. The relatively small impact may be related to the fact that most incidents affect only the Internet site, whereas the mission-critical information is usually located on the internal IT-infrastructure.

Despite the relatively limited impact on the operations of the organisations, the incidents can be very annoying. In roughly half of the incidents, the perpetrator misused the hacked systems for spreading undesirable information (such as illegally copied software or Website hacking) or for launching attacks against the computer systems of other organisations, which can be quite embarrassing for the affected organisation. Furthermore, the system administrators spend on average half a week for each incident.

Ten out of the seventeen unauthorised access incidents were reported as caused by bugs in software. From the name and version number of the concerning software, it was determined that five incidents were caused by bugs that were well known at the time the incident took place and for which a fix was available. These incidents, therefore, are in fact caused by not timely installing security fixes. This may be related to the high workload of the responsible system administrators, as in three organisations that have become victim of incidents caused by not timely installing fixes, the pressure of work, as described by the system administrator, was high. In two cases it was even noticed that "the urgent tasks and requirements coming from the organisation take so much time that there is frequently not enough time left for necessary (less visible) maintenance."

8.2. Denial of Service

With three out of 145 organisations reporting denial of service incidents, it can be stated that these kinds of incidents are infrequent, despite the fact that they can relatively easily be caused. Apart from being a nuisance, the incidents did not have any serious consequences, such as a significant loss of productivity or missed turnover.

8.3. Malicious Code

Despite the current attention for the security problems in Java and ActiveX, no incidents with respect to active content were reported. The incidents concerning malicious code, as reported by 9 organisations, were all related to MS Word macro viruses spread by e-mail. These viruses, however, can cause considerable damage. This was indicated by the fact that:

- usually several systems were infected (in one incident even up to 45);
- the system administrators spent much time with the handling of the incidents (sometimes several days);

- there is a realistic chance of passing the viruses through to business relations, something that happened to two of the responding organisations.

8.4. About the Perpetrators

Based on the actions the perpetrator undertakes when he has gained unauthorised access to a computer system, his objectives can to some extent be deduced.

From the incidents as reported by the responding organisations, it can be stated that most intruders are not really interested in reading or modifying business-critical data. The information that was read or modified usually consisted of data like logfiles, network traffic, Webpages or system binaries. Not a single responding organisation mentions incidents whereby the perpetrator has read or modified any truly sensitive data, such as customer files or financial data.

The perpetrators are more interested in the network facilities. In approximately half of the unauthorised access incidents, the hacked computer systems were misused for activities like Website hacking, the distribution of illegally copied software or for launching attacks against the computer systems of other organisations. In some cases the intruder was eavesdropping the network traffic. The fact that eavesdropping intruders were also being reported by Internet providers means that it is certainly advisable to use strong encryption when sending sensitive data over the Internet.

Another indication that most perpetrators have few interest in gathering business critical data, is the fact that among the organisations reporting unsuccessful unauthorised access attempts, more attacks are reported with respect to the Internet site than with respect to the internal IT-infrastructure.

One of the first priorities of an intruder after having launched a successful attack is to safeguard his access. In almost half of the incidents concerning unauthorised access, the perpetrator realised new means of access; such as by adding new accounts, installing Trojan horses or reading the password file.

Most intruders can probably better be described as joyriders than as vandals or criminals. They break into a system not to gain any financial profit (the affected organisations rarely suspect any financial motives) but to fully enjoy the power of the computer system and it's network facilities.

The intruders do not necessarily possess a high level of expertise, as many of them make use of well-known techniques.

In only two incidents the intruders were prosecuted.

8.5. Additional Security Measures

Organisations affected by attacks or incidents often take additional security measures:

- almost all organisations confronted with unauthorised access incidents have implemented additional security measures. The reported measures often do not require a continuing effort nor any additional resources apart from a certain amount of man-hours of the system administrators;
- the few organisations affected by denial of service incidents all have implemented measures to prevent further incidents;
- two thirds of the organisations that became victim of malicious code incidents improved their virus checking as a result of the incidents;
- among the organisations exclusively detecting unsuccessful attacks, about half have implemented additional security measures.

It appears that most organisations are not fully aware of the risks of their Internet usage until the first attack or incident takes place. The chance of attacks is relatively high, up to 45% during 1½ year, so it makes sense to implement appropriate security measures before being confronted with the first attack.

9. Effectiveness of Security Measures

The survey measured the effectiveness of several kinds of security measures: the presence of a firewall, security policies, the presence of security audits and the quality of the system administrators.

9.1. Effectiveness Firewall

A firewall is an often-used technique to establish a secure link between the Internet and the internal IT-infrastructure. In this survey it was measured to which extent the presence of a firewall actually contributes to the security of the internal IT-infrastructure. This was done by comparing the percentage of organisations experiencing security incidents on their internal IT-infrastructure for both the group of organisations with a firewall and the group of organisations not having a firewall.

Strangely enough, the percentage of companies experiencing Internet security incidents among the organisations having a firewall is not any less than among the organisations not having a firewall.

A possible explanation is that not all firewalls are of proper quality. This was indicated by the following findings:

- one out of four organisations reported that they have implemented a policy of allowing all services to pass through the firewall, other than a few services that are explicitly blocked. The main danger of such a *default permit* policy is that because of the great number and complexity of network services it is fairly easy to overlook a certain kind of dangerous network traffic. It is therefore advisable to allow only explicitly authorised network traffic, and block all other traffic [Chapman & Zwicky 1995];
- one out of ten organisations having a firewall offers the possibility of inbound logins without necessarily using encryption, one-time passwords or some other means of strong authentication. The danger of this situation is that if an eavesdropper manages to intercept the password, he can logon as a normal user [Garfinkel & Spafford 1996];
- at two organisations, the firewall had been installed by an external expert without any kind of maintenance ever since.

The above criteria are necessarily incomplete and could therefore only be used to get a rough impression of the quality of the firewalls, as a more thorough measurement would be too extensive to fit into the survey.

A second explanation for the poor effectiveness of the installed firewalls can be given by a closer examination of the incidents that broke through a firewall. It was found that 5 incidents could be reduced to security holes in the firewall itself:

- in one case the services passed through the firewall were handled by software containing security holes;
- in the case of another incident the entire firewall (at least the security part of it) was out of service without the organisation being aware of it;
- in the case of three incidents the firewall did not check on incoming e-mail, causing MS Word viruses to be able to reach the internal IT-infrastructure.

One other incident concerned a computer system reported as part of the internal IT-infrastructure but located outside of the firewall. The two remaining incidents were not being reported in enough details to be able to determine the cause.

The frequent poor quality of firewalls is being confirmed by the people of KPMG doing penetration tests. They report that in one out of five cases they manage to break through the firewall. As the organisations that ask KPMG to do a penetration test often spend a more than average effort to security, it is likely that the total percentage of organisations having security holes in their firewall is more than 20%.

9.2. Organisational Aspects of Security

The survey has tried to measure the effects of the following organisational security measures, taken from [BSI 1993] and [OTB 1997]:

- a written security policy;
- an explicit assignment of security related responsibilities;
- security clauses included in the *Service Level Agreement* (SLA's) if the organisation makes use of them;
- a written policy with respect to the risks of the Internet connection, if such a connection is present;
- user awareness measures;
- management involvement in the selection of services allowed to pass through the firewall;
- the existence of procedures and guidelines with respect to incident response.

To measure the effects of these organisational security measures, two groups of organisations were assembled: those having implemented many measures and those having implemented few. The difference between many and few was defined in such a way that both categories contain exactly 50% of the relevant responding organisations.

Surprisingly, the group of organisations that have implemented many organisational security measures does not have any fewer incidents than the other group. A possible explanation is that, in order to have an effective security, the organisational measures must be translated into operational procedures, as few intruders will be stopped by measures like security policies, job descriptions or user awareness sessions by itself. The organisational security procedures are, therefore, only useful if they actually result in adequate operational security measures, most of which are related to the technical configuration of the computer systems.

To measure the effects of the organisational measures on the implementation of operational procedures, the emphasis was laid on one specific operational procedure: a regular check of the system logfiles. For each organisational measure two groups of organisations were formed, those with and those without the measure. In most cases it was found that the group of organisations having implemented the organisational measure did not have a significantly higher percentage having implemented a regular logcheck than the group without the organisational measure. If this trend also appears at other operational security measures not included in the survey, than it can be stated that the effect or security policies and other organisational measures upon the quality of the operational procedures is frequently insufficient.

9.3. Auditing the Security

As a significant part of the incidents was detected by checking the logfiles, special attention was being paid to the effects of a regular audit on the logfiles. It turned out that the number of incidents reported with respect to the Internet site was significantly greater with the organisations performing regular logchecks (18% reported incidents) than with organisations that check the contents of their logfiles only if there is a direct reason to do so (6% reported incidents). If the organisations without adequate detection measures are under the same pressure of attacks as the organisations that do have adequate checks, then it can be assumed that the former group is having security incidents without being aware of it. This assumption is being confirmed by a further analysis of the reported security incidents. It turns out that the "silent" attacks, where the perpetrator merely reads information without undertaking any further actions that might draw the attention on the incident, were exclusively reported by organisations that have implemented procedures for incident detection. Organisations that do not have regular security checks, on the other hand, were only reporting incidents with a relatively high visibility, such as where the perpetrator undertakes actions like Website hacking, attacks on other sites or modification of system binaries.

If organisations without proper detection measures have the same chance of being (successfully) attacked as those that do have adequate detection measures, it can be inferred that approximately 12% of the former group is having Internet related security incidents without being aware of it.

If 18% of the organisations are having incidents, while only 6% of the organisations without adequate detection measures are aware that such incidents have taken place, then the latter group has managed to detect only one third of the incidents. This however, is relatively modest compared what other researchers have found. For example, a test program by the *Defense Information Systems Agency* (DISA) found that 96% of the succeeded penetration tests carried out by DISA was not being detected [GAO 1996]. A research carried out by the *Air Force Information Warfare Center* (AFIWC) found that only 13% of the attacks was being reported [Howard 1997].

9.4. Quality of the System Administrators

Security often depends on people. The survey has tried to find out which human factors have a significant effect on the effectiveness of the security. The focus was on the system administrator, as he was the person filling in the questionnaire. From the information provided, it was inferred that the following factors are important when security is at stake:

- the level of knowledge. Because a direct measurement would be unfeasible, the level of knowledge could only be measured by indirect means. The level of knowledge has therefore been measured by asking whether or not the system administrators are members of a user group, as these are specifically aimed at the exchange of knowledge among their members;
- the level of experience with the administration of Internet services;
- the pressure of work. In 30% of the responding organisations the pressure of work of the system administrators is on such a high level that overtime is regular (more than once a week) or that the urgent tasks and requests coming from the organisation take so much time that insufficient time is left for doing

structural maintenance. In this situation it is up to the professionalism of the system administrators to – despite the high workload – pay enough attention to important things not immediately visible to the users, such as computer security. It is, however, the task of the management to structurally improve this situation.

10. Conclusions and Recommendations

With up to 45% of the Internet connected organisations under attack, it is safe to state that security is an essential requirement for anyone connecting to the Internet. Although this threat is present for practically every Internet connected organisation (regardless its size or the sector it operates in), most organisations do not seem to be fully aware of it.

Most security incidents seem to be affecting the Internet site instead of the internal IT-infrastructure, which causes the impact to be relatively low from a business point of view. This, however, does not mean that security is irrelevant, as in roughly half the number of incidents the intruder uses the systems in a way that can potentially embarrass the affected organisation.

A significant part of the incidents concerning unauthorised access could have been prevented by timely installing security fixes.

When considering malicious code, it appears that MS-Word viruses, spread by e-mail, are currently a far greater problem than Java or ActiveX. It is certainly advisable to have virus scanning on incoming e-mail, such as being offered by several commercial firewall products.

The sole availability of a firewall does not always provide a proper protection. Without careful planning, testing and maintenance, a firewall can provide a false sense of security.

The effect of security policies and other organisational security measures is somewhat disappointing, as not every policy results in the actual implementation of effective operational security measures. The security policy should state clear procedures for measuring the resulting operational measures.

The survey added further evidence to the fact that without adequate detection measures, only a small part of the incidents will be detected. Detection measures are, however, an important aspect of security as they enable an organisation to respond to incidents in an early stage.

Human factors have a clear influence on the security. Especially the level of knowledge, experience and the absence of a high workload among the system administrators have a positive effect on the security.

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Considerations in Collaborative Lesson Development on the Web

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Abstract: This report is work that began during the summer of 1997. The research has as its hypothesis that technology rich lessons will increase the performance of low achieving students (grades 3-8) on standardized end-of-grade tests. The lesson development has emphasized three factors that have been agreed upon by each district. The factors called for a thematic unit with each unit being developed using Howard Gardner's Multiple Intelligence theory and the constructivist theory in its preparation. The project has utilized several on-line systems including the free system from nicenet.net, the Lotus Domino server, Learning Space, and Xerox's DocuShare. This paper will describe the pros and cons of each system tried and the teachers' reactions to them. The effectiveness of on–line development as well as considerations in choosing what should NOT be done on-line but in person are discussed.

1. Introduction

The ABC Technology Consortium is an Innovative Challenge Grant funded by the US Department of Education in 1996. This grant has as its basic premise that technology rich lessons will increase the performance of low achieving students (grades 3-8) on standardized end-of-grade tests.

Part of our reason for thinking that technology-rich lessons will help students grew out of our study of constructivism. When one considers the media rich environment that today's students have been exposed to since before birth, it seems to be logical to make this assumption.

Today's infants grow up with huge woofers booming sound even prenatally. This electronic assault continues into early childhood. Children are exposed to all sorts of electronics from large screen televisions, cell phones, Nintendo, and other things we take for granted. So do the students!

Students are accustomed to instant information. They "need" to be kept *wired* during their learning. This perceived need presents tremendous challenge to today's teachers since educational infrastructure has changed little from its industrial era mentality. Educators doing things as groups, in order, and on a schedule – learn my way, when I want you to – seems to be the prevailing philosophy.

Media-rich lessons will, certainly, not solve all problems in student learning, but our hypothesis is that it will help. Preliminary data indicate that this approach is having some effect. One of our targeted schools has improved its writing scores by over 600%!

There are five separate school systems participating in the grant. They cover a broad geographical area (over 120 miles distance for the two districts furthest apart). There are 1500 teachers in the districts and they have committed themselves to producing a technology rich curriculum which emphasizes the creation of multimedia materials that are to be delivered on-line. The distances involved in the project eliminate easy, face to face meetings. The differences in district calendars and school days mandated an asynchronous method be used for effective lesson development.

The districts are Guilford, Person, Stokes, Surry, and Wilkes County Schools. Part of the reason for the grant selection by the Department of Education was based on the demographics of the districts.

The reported demographic data are shown below:

1995 Data	Guilford	Person	Stokes	Surry	Wilkes
	54,756	5,273	6,325	7,342	9,760
% Below State Standard					
Reading (3-8)	29.0	31.1	32.8	26.8	29.4
Writing (4)	47.2	52.4	41.8	44.2	43.3
Writing (8)	43.7	46.8	30.6	28.6	29.5
%Free/Reduced Lunch	33.7	39.0	26.8	28.7	34.9
# Of Schools	21	5	5	5	6

Demographic makeup of the districts has not changed appreciably since the grant's inception in Spring 1996. Population has increased but the other data remain practically constant. This enables us to maintain a relevant data collection.

The lesson development has emphasized three factors that have been agreed upon by each district. The factors called for thematic units rather that just lessons. Each lesson is developed using Howard Gardner's Multiple Intelligence theory. Also each lesson uses the constructivist theory in its preparation.

The project has utilized several on-line systems including the free system from nicenet.net and the Lotus Domino server. Several other systems were considered including Learning Space and Xerox's DocuShare.

2. LearnNC Partnership

We entered a partnership with the Institute for Academic Technology at the University of North Carolina at Chapel Hill. The particular effort we joined is called LearnNC. LearnNC utilizes a Lotus Domino server. The strengths of using this approach are the immediacy of postings being available, the ability to selectively password protect sections, the ability to have a web presence, and the ability to enter into collaborative work in the group section.

There are many features of the Domino system that are not currently being used. A key concern of the sponsor (LearnNC) is that user difficulty be minimized. As teachers become more familiar with the system, more features might be utilized.

LearnNC provides its service without charge to every teacher and school in North Carolina. This allows for the widest possible usage. The ABC template varies only slightly from the base template which every NC teacher can use. The key differences lie in identifying the various multiple intelligences being targeted and in having a student work space attached to the lesson but also separately accessible. Since the ABC Grant is a federal grant, all lessons are fully accessible to all teachers. The URL is http://www.learnnc.org. While anyone may view the lessons, in order to post, one must have a password to access the system. A sample lesson and the template can be seen at the URL referenced above.

One possibility that we have used for collaborative lesson development is for one teacher to take the lead and post a lesson. The collaborators then check the posted material and email the original author who makes the changes. This was not an ideal solution so collaborative accounts have been set up so that each collaborator can have total access to the lesson(s) being posted. There are some potential problems with this method, but it seems the best available alternative at the moment. This shared account posting method is asynchronous at the moment but ways to make it synchronous are being explored.

Discussion forums using a threaded format make it possible for interested parties to exchange ideas and for anyone to participate in the sharing. One disadvantage to this type of discussion is the difficulty new users have in knowing where exactly to post. It is also possible to respond via email to a posted message without posting for the entire user group to see.

3. Southeast Cluster Partnership

The ABC Consortium is one of fourteen Innovative Challenge Grants to comprise the Southeast Cluster. The Cluster comprises projects in Pennsylvania, Delaware, Virginia, West Virginia, North Carolina, South Carolina, Florida, Louisiana, and Tennessee. Each project has a short description at the following URL http://www.se.ticg.jhu.edu. Several components of the Cluster site are related to sharing and posting. One of the primary components is called DocuShare that is produced by Xerox. This component is password protected on the Cluster site lending itself to private conversation between members. Not all features available in DocuShare are being used. The two, which are being used, are the bulletin feature and the folder and document sharing.

The bulletin feature allows anyone (with the requisite access) to post a newsflash or a short announcement which everyone should read. One advantage of the program is that a date tag can be added so users can check for recent news. A disadvantage is that the date stamp must be manually adjusted.

Users having the proper level of access can add folders and documents. This is a very powerful feature because it is possible, for example, to get groups that cannot see the post; can see but not change; and can see and change. These levels of access can be set by the poster and do NOT require the intervention of the web guru. In our case, we have not taken the access down to the teacher level – it remains at the district level for the time being.

The WebBoard program by O'Reilly & Associates allows for discussions in much the same way that Lotus Notes does. Here there are folders that can be added for holding particular discussion postings. It is possible in this section to allow selective access just as was the case in DocuShare.

Attachments can easily be added to the discussion topics. One disadvantage in that the new message tag which alerts a user when they sign on must be reset manually, otherwise users get every message as NEW now matter how many times they've read it. A plus is that a user can set an email notification property that automatically lets him/her know when any new posting occurs. This is helpful for busy people when the amount of posting is relatively small.

4. NICENET.ORG

Not enough good things can be said about nicenet. Perhaps the most important is that it is free! This program does not have all the bells and whistles that the commercial offerings have. It does have a discussion component, a presentation component, and the ability to link users via email.

This site is probably best used for a teaching purpose even though it is flexible enough to allow for collaborative work. Teachers who used this site liked the presentation quality but found collaboration difficult. If one has a need for an on-line cyberclassroom then nicenet should be considered. The URL is http://www.nicenet.org.

5. Basic HTML

During the first summer of the ABC project, we used Netscape Navigator Gold to produce thematic units suitable for posting to the web. Our teachers were in structured workshops that allowed them to collaborate on lessons, see the code for presenting the information, and modify the code. The group activity allowed sharing and any dispute/discussion was easily handled during the sessions.

When the lessons were done in the home schools, there was, of necessity, a need to involve a referee in this collaborative effort to look at the conflicting versions and decide which should be posted. This work required ftping documents online or by using *sneaker.net.* Using HTML was fine if there was a face to face meeting of the collaborators but less effective with the distances in the grant. Teachers decided rather quickly that there had to be a better way for on-line collaboration.

6. Conclusions

In using the various systems, the teachers are really enthusiastic about the Lotus Domino solution. Part of the acceptance here might be the very strong statewide push for training in this program. Nevertheless the teachers accept and use this program very well.

Second in order comes the DocuShare program for Xerox. The most ardent supporters are those with a little more technical expertise. Whether the training curve has not turned up or the program is harder to master, the rank and file teacher seems more reluctant to utilize it regularly.

Nicenet is very easy to use but teachers seem not to use it except as a learning tool. It is not used as a collaborative or discussion vehicle.

The same can be said for HTML – it is just too complex for regular use and teachers use it only for special purposes.

Little concern has developed over what should be done on line and what should be done face to face. One conclusion, which may be valid, is that since teachers are people-oriented they prefer, in most instances, human contact. Perhaps only time and experience will enable teachers to become totally comfortable in cyber-meetings and cyber-collaboration.

Acknowledgements

The author wishes to thank the following members of the ABC Consortium for all their hard work and efforts on behalf of the program: Guilford County-Zelia Frick, Dr. Chuck Morris, Michael Parrish, Donna Yow; Person County-Sandy Davis, Russell Dixon; Stokes County-Arden Browder; Surry County-Dr. Judy Flake; Wilkes County-Chuck Parker. In addition, all the teachers from all the districts who have worked on the program and provided valuable input on the various collaborative programs deserve a great thank you. Of course, the Technology Innovative Challenge Grant program which has provided the funding for the entire effort deserves accolades.

Extensions for Alternative Presentation of HTML Information

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Abstract: The typical way of accessing HTML information has been the utilisation of WWW browsers. These applications have inherited their way of interacting with the final user from other common Windows applications. The use of *standard* toolbars, scrolling bars, buttons, etc has confined the presentation of HTML information within the limits of the browser window. The purpose of this project is to suggest the possibility of designing and presenting HTML information isolated from the constraints that the current browsers impose. This will be possible thanks to the definition of a new set of tags and parameters and a browser capable of parsing such extensions.

1. Introduction

This paper describes the object oriented design and development of an HTML browser capable of parsing a set of new HTML extensions. These extensions are intended to enhance the control of the HTML document author over the graphic interface of the visual environment where the information is being displayed. Implementations to demonstrate their behaviour have been carried out on a PC platform, on top of the Win32 API. Since we are only talking about extensions, total compatibility of both the new browser with actual documents, and the actual browsers with documents including the mentioned extensions, is guaranteed.

Our intention is to present an alternative to the current ways of showing HTML information, that is, to the browser constraints accepted by WWW users. We, of course, do not intend to assume the enormous effort required to develop and maintain a new complete browser. Our aim is to suggest a more generic visualization policy; for this purpose, we have developed a browser that interprets a new reduced set of HTML extensions, along with the most common standard ones. Such extensions are a set of 'tags', and their associated parameters, that mainly allow the author to control the fully independent area where the information is going to be displayed, and the way this area will interact with the platform windowing system. The available area properties currently include size, position, transparency, and movement.

HTML related technologies do already allow authors (via the use of transparencies, animations, hot areas, etc.) to design friendly user interfaces free of buttons, check boxes, scrollbars, combo boxes, and other standard graphic controls whose effectiveness for novice users is not clear. The problem is that currently all this information should still be confined into the browser frame, not only limiting the designer freedom by the constraints commonly imposed by the windowing systems, but also by the ones imposed by a the client area of a single window. The objective of the work in progress, similar to many other user interface enhancement initiatives [Grudin 93], is to give the author the possibility of showing HTML information outside the browser frame or any other frame but the screen.

2. Description

By parsing the proposed extensions, our browser (now just a small toolbar, without client area) is able to show throughout the screen bare information free of title bars, buttons, borders, tool bars, etc. Composition of different documents, either separated or overlapped, either transparent or opaque, either with full window frame or without even a border frame, allows the author to play with a series of new original possibilities. Moreover, a movement parameter makes possible to specify an initial position for the document's window, a type of movement (now just linear or circular) and a set of options to determine the trajectory of the window.

These few extensions, along with the possibility to link several URLs with a single anchor [Pimentel & Buford 96], allow sets of HTML documents to act, for instance, as virtual remotely maintained desktops covering the whole screen, or just a part of it, by simply specifying the borderless, non-moving, no resizing and transparent parameters. As a paramount part of the WWW facilities, advertising would find a new range of possibilities; for instance, Internet providers could display their animated logo in one corner of the screen (or moving around it) without disturbing the user navigation. Definitely, the appropriate combination of these tags and parameters will provide authors with much more power to design their multimedia presentations.

The sintax of these extensions is as follows:

```
<LAYOUT
  POSITION= x, y, width, heigth                    // initial coordinates  for he window
  PROPERTIES =                                     // window properties
        BORDER,                                    // border arround the window
        SIZEFRAME,                                 // resizable window
        MOVEFRAME,                                 // window with title bar
        OVERLAPPED,                                // overlapped window
              POSRELATIVE,POSABSOLUTE,             // relative or absolute initial coordinates
        of the window
        TRANSPARENT                                // transparency of the wholewindow
  MOVEMENT =                                       // window movement
        LINEAR, vx, vy                             // linear movement, horizontal and vertical speed
        CIRCLE, r, 1/0                             // circular movement, radix, positive/negative rotation>
```

In fact, all the work we are carrying out is a much more generic approach to the currently available frames inside the browser, which is just a partial solution, in our point of view, to a real user requirement. Current status of the developments does already allow to have a clear image of the proposal.

3. Related Work

Although when we started the design of this work, we did not find any other simmilar idea in this direction (maybe due to the fact that requires the implementation of a new browser to effectively show it, a work that, due to several reasons, is seldom found [Verhoeven et al. 98]), it is evident that it was already evolving in the largest browser developers premises. The first actual step in this direction is the Active Desktop [Microsoft 97], recently fully implemented in the Explorer. Independently of the automatic updating mechanism that includes, the main differences are that, first, they only consider the desktop, not a generalised new approach for document visual behavior; and, second, it is the user, not the information provider, who decides the appearance (just position, not transparency nor movement) of WWW information, always just on the desktop.

4. References

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High-level Database Document Specifications Using XML

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Abstract: Reporting information stored in databases for use in different environments is not an easy task. Most database management systems do not provide integrated tools that can be used for, say, both on-line information browsing as in the World-Wide Web and information retrieval for static use (e.g. paper printing). The system discussed in this paper implements a flexible method, based on the new standard XML (eXtensible Markup Language), to generate database reports. XML is chosen for its processing capabilities with parsers and processors, it is not used as a replacement for HTML, so the output we serve to the WWW-clients is still in HTML.

1. Introduction

Retrieving information from databases and presenting it to users in different formats, such as for on-line browsing on the World-Wide Web or printed reports, has always been a difficult task. Most database systems provide proprietary tools to generate reports for paper printing or have special tools for information reporting towards the WWW. Examples of these tools are Oracle's SQL*Forms, WebServer, and Microsoft's Internet Assistant for Access. There are few integrated systems for reporting information for different uses.
Our system is developed in the Hypermedia Object Management Environment [HOME] framework. The techniques and methodologies presented in this paper were developed during the implementation of a database application for the Department of Computer Science of the Katholieke Universiteit Leuven (B). Characteristic for this department is its diversity in computer platforms and operating systems, so the systems needed to be flexible and platform independent.
Using XML [XML] as a specification language, enables us to make flexible high-level documents and generate output in different environments, such as on-line browsing on the World-Wide Web and paper printing. The system differs from other systems for database access, as it uses document templates to generate the output (HTML or other).
In this paper, we will first discuss the different high-level concepts we are using in the information templates. The presentation of these concepts is given from the viewpoint of the report-generator, so the elements we discuss might not be exactly the elements one expects in a relational database. The second part is a discussion of the DGReport document type definition (DTD) in XML, and the third part describes the report generator.

2. High-Level Reporting Elements

Looking at relational database schemes, we can discover three kinds of elements that are important in generating reports. These elements can be derived from the use of database tables while retrieving data out of the database. We take a navigational approach to retrieve data out of the database, in contrast with SQL data retrieval where a descriptive approach is followed. During the retrieval of the information, the system always works with a specific table, the *current* table, from which it will retrieve some tuples. In the figure below, for example, this could be the table PERSON. All information retrieved will come at first instance from the current table, and information

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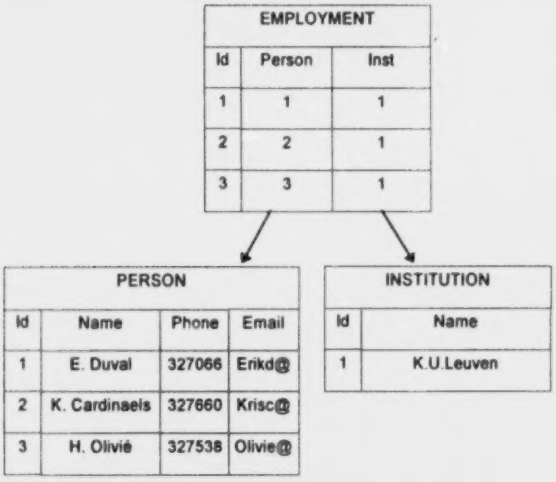
retrieval will always start from this current table. But of course, while looking at the current table we may need information from another table if necessary, and thus change the current table.



EMPLOYMENT

Id	Person	Inst
1	1	1
2	2	1
3	3	1

PERSON

Id	Name	Phone	Email
1	E. Duval	327066	Erikd@
2	K. Cardinaels	327660	Krisc@
3	H. Olivié	327538	Olivie@

INSTITUTION

Id	Name
1	K.U.Leuven

Figure 1: Relational model for employees

1. The first kind of element is the simplest one. It corresponds to attributes of the current row in the current table. In Figure 1, the attributes of the current table PERSON are *Id*, *Name* and *Phone*. Attributes can be retrieved from the table and inserted in the generated document. For example in Figure 2, three attributes are represented as columns in a generated document for employees.

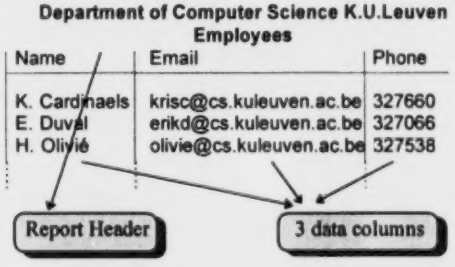


Figure 2: Example document for employees

Generally, a document is made up of combinations of attributes of different tables.

2. The second kind of element is related to single values from other tables, refered to by foreign keys in the current table. During the generation of the report we may want to follow the reference to the referred table and include some columns of that table (join the current table and the referred table). Notice that we only insert one tuple of the referred table in our generated report, in contrast with the next element, discussed in 3. At this moment the current table changes to the referred table. In the example of Figure 1 we have an employment which states a relationship between a person and an institution. The table employment contains references to both the person and the institution, but we do not want the values of the foreign keys to appear in our document. Rather, we want for example the initials and last name of the person and the name of the institution. So, in this example if the current table changes to the person table, and the process can restart: attributes of the new current table can be included, and so on... The same method is used to include attributes of the institution table.

3. Using the employment example, we can discover the third kind of element when generating a report for an institution: a repeating list of values from other tables, referring to the actual tuple of the current table. One of the report elements we want to insert could be a list of employees with their name, e-mail address and phone

number (as given in Figure 2). If the current table for the document is the institution table, we insert a join with the employment table in the document. This join returns a list of tuples according to the employment reference. As in the previous element, the current table changes to the joined table and elements can be inserted in the document for the new current table.

3. High-Level Element Specification

Our system uses XML to specify the information templates. We rely on XML as a *template specification language*. Documents generated from the template can, but need not, be XML documents themselves. They can just as well be ordinary HTML documents, or formatted text, or any other character-based format. At the moment a lot of work is going on to make XML the standard language for the World-Wide Web and thus replacing HTML. So, web-documents would be marked-up with XML tags, which can be seen as a generalization of HTML.
In contrast with this use of XML, our system uses XML for its processing capabilities. The first step in our system is an XML parser that parses the information template and passes the parsed XML tree on to the next processing step. The output from our system is an HTML file that can be served on the Web. It also possible to generate XML in stead of HTML as the final output, no changes need to be made to the system, only the report template has to be altered.
We have chosen XML for its flexibility and the number of available tools to parse and process the templates. In addition to the three main elements described above, some additional ones have been declared. The next paragraph describes all these elements and their use in the information server. Figure 3 shows the Document Type Definition we defined for the information template.

```
<!ELEMENT dgreport    (dghead, dgbody,
                      dgfoot)>
<!ENTITY content      (#PCDATA | column |
                      reference | repeat)>
<!ELEMENT dghead      (#PCDATA)>
<!ELEMENT dgfoot      (#PCDATA)>
<!ELEMENT dgbody      (&content;)*>
<!ELEMENT column      empty>
<!ELEMENT reference   (&content;)*>
<!ELEMENT repeat      (&content;)*>

<!ATTLIST dgreport
        table CDATA #REQUIRED>
<!ATTLIST column
        column CDATA #REQUIRED>
<!ATTLIST reference
        table CDATA #REQUIRED
        column CDATA #REQUIRED>
<!ATTLIST repeat
        table CDATA #REQUIRED
        column CDATA #REQUIRED
        sep CDATA #REQUIRED>
```

Figure 3: Information Template DTD

<dgreport>
Serving information out of a database always starts from a certain table or view. The name of this table must be specified at the beginning of the template, as a parameter of the *dgreport*-element.

<dghead> and *<dgfoot>*
Every document can contain one header and/or footer. These two elements are processed only once for the whole document. For the time being, the header can only contain static text, values that need be retrieved from the database are not allowed. A more elaborated model could allow special columns to be included in the document,

which can be retrieved from a dummy table (e.g. sysdate from dual in Oracle in order to include the date the document was generated) or summary information like totals or counting for the table.

<column>

The body of the document (dgbody) can include values that must be retrieved from the current table. For each tuple in the main table (given in *<dgreport>*), the system will process the body of the document and replace all column elements with values from the database.

For example, when we are generating a list of people, we will need the first and last name of the person and his address. For such a report we thus add three column tags specifying that we want these values to be included (see Figure 4).

```
<DGREPORT table="PERSON">
<DGBODY>
<COLUMN column="FName"/>
<COLUMN column="LName"/><BR>
<COLUMN column="Address"/>
</DGBODY>
</DGREPORT>
```

Figure 4: Information template for employee labels

In this example the three column elements will be replaced with the appropriate values for each tuple in the person table. Figure 5 illustrates a possible result from this template.

```
Kris Cardinaels
Celestijnenlaan 200A, B-3001 Heverlee

Erik Duval
Celestijnenlaan 200A, B-3001 Heverlee

Henk Olivié
Celestijnenlaan 200A, B-3001 Heverlee
```

Figure 5: Person labels from the template in Figure 4

<reference>

Foreign keys can't be included directly into the document. A foreign key references to the primary key of a tuple in another or the same relation in the database. Specifying a *<reference>* in the document template starts a lookup (join) to the referred tuple: the current table changes to the referred table. After the current table switch, we can specify which columns of the referred tuple we want to include. So, between start and end tag of a reference we can specify a number of elements. The next figure gives an example using a reference from the employment table to the person table.

```
<DGREPORT table="EMPLOYMENT">
<DGBODY>
  <COLUMN column="id">:
  <REFERENCE table="PERSON" column="person">
    <COLUMN column="name/>, <COLUMN column="phone"/>
  </REFERENCE>
</DGBODY>
</DGREPORT>

Could generate:
1. E.Duval, 327066
2. K.Cardinaels, 327660
3. H.Olivié, 327538
```

Figure 6: Alternative information template for employees

<repeat>

A repeat element corresponds to a join of two tables that can generate a list of values. For a tuple in the first table, a list of tuples is returned which all refer to that first tuple. Repeat elements are more or less similar to reference elements: with references we look for the referred element, with a repeat we look for all elements that refer to the current tuple.

Because the repeat element returns a list of values, we want that list to be returned in a formatted form. Therefor two attributes (*sep* and *last*) can be specified that handle the separation of the list elements. Consider for instance the document in Figure 7 that concerns published articles. The first element in this document is the repeating field *author*. The resulting report will include the authors separated from each other with a comma, as specified in the *sep*-attribute. Optionally, the *last* attribute can be used to make a distinction for the last separator in the list. In Figure 7, we use a comma to separate authors and the word 'and' to use as last separator.

```
<DGREPORT table="ARTICLE">
<DGBODY>
<REPEAT table="AUTHOR"
        sep=", " last=" and "
        column="author_article">
  <COLUMN column="initials/>.
  <COLUMN column="lname"/>
</REPEAT>,
<IT><COLUMN column="dname"/></IT>.
</DGBODY>
</DGREPORT>

Could generate:
K. Cardinaels, E. Duval and H. Olivié, High-
level Database Report Specification Using XML.
```

Figure 7: Bibliographic information for published articles

4. Report generation

As explained in the previous section, our system uses an XML template to generate its documents. Starting from the XML file, an XML parser parses the document and passes an XML tree to the second process in the system, that we call the XML-consumer. This second process connects with the database and generates the document, which will be given to the HTML server.

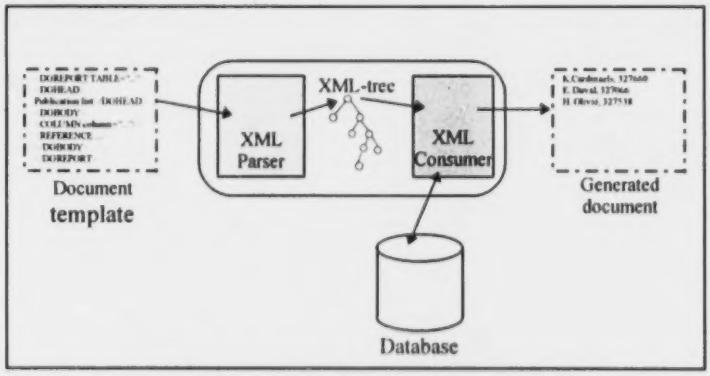


Figure 8: The Information Server Process

With this kind of implementation, it is easy to generate documents for different uses. When we want printed documents we can redirect the output to a file and print that file. For online documents on, e.g. the World-Wide Web, we use a simple servlet mechanism to redirect the output through a webserver.

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A second advantage of our system is the use of text-templates. Any kind of output-template that can be written in standard text format, for example, with the ISO8859-1 (Latin-1) character set, can be processed with our information server. Of course, ASCII and HTML outputs belong to this category, but also TeX and other output formats can be generated.

5. Conclusions

While developing a database application to be used at the department of Computer Science at the Katholieke Universteit Leuven, we ran into the problem of serving information out of the database to different media and on different platforms (both on-line and for printing). Using XML provided us with a flexible solution to generate such information. While studying the high-level design and the implementation phase of database applications we could define a document type definition for database information templates.

This method of retrieving information from databases for the Web differs from most other systems that allow database information retrieval. In comparison, we can distinguish two other methods for serving database information on the Web.

1. The first method uses non-standard extensions of the HTML-language to embed database query facilities (e.g. SQL-tags) or to allow scripting within the HTML document. Professional Home Page [PHP] and Microsoft's Active Server Pages (ASP) [ASP] are examples of such systems. PHP is a scripting language that can be embedded in HTML documents with specific functions for accessing databases. The web server will process such non-standard HTML and embed query results in the HTML document. Also ASP allows scripting within the HTML documents, but the tools provided in this system can be more complex, such as ActiveX components that access databases.
2. The other category of information servers are specific Web-servers with extensions to access databases. This category is not exactly the same as our mechanism, as we use standard Web-servers, like Apache, with servlet extensions. Servers in this category are for example HyperWave with the Place [HyperWave] language (this system also uses a proprietary database server) and CGI-based servers that embed SQL commands in their scripts.

Most of these systems require specific servers or processors and even special databases, in comparison with our system, they are less extensible and less flexible.

The approach described in this paper fits in the 'Hypermedia Object Management Environment' or HOME framework for research in the domain of databases and hypermedia [HOME]. Our research is mainly concerned with different approaches to the application of database technology for hypermedia systems. Two extreme methodologies in our work can be distinguished:

1. In the first one, the database and the hypermedia application are developed manually. This method is mainly used for very leightweight applications, in the context of HOME-LITE.
2. The other extreme starts from the analysis phase of the application domain and generates automatically the database application, as well as Java classes that interface with the database. Client applications are then developed in the JavaBeans application development framework [Hendrikx98].

The approach presented in this paper belongs somewhere inbetween these two approaches. The difference with the first one is that we do not program every interaction with the database manually. It is different from the second one, because the information templates aren't generated automatically.

6. References

[ASP]	Active Server Pages, Microsoft Corporation, http://www.aspdeveloper.net
[Hendrikx 98]	An Integrated Methodology for Designing Web Applications, *WebNet 98*, accepted
[HOME]	Hypermedia Object Management Environment, http://www.cs.kuleuven.ac.be/~erikd/MANUAL/home.html
[HyperWave]	HyperWave, the PLACE-template language, http://www.hyperwave.de/program/prog02.htm
[PHP]	Professional Home Page, http://php.netvision.net.il
[XML]	Extensible Markup Language, World Wide Web Consortium, http://www.w3.org/XML/

2ND INFANTRY DIVISION'S TACTICAL WORLD-WIDE WEB: AN EFFECTIVE BATTLEFIELD INFORMATION SYSTEM

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Abstract: 2nd Infantry Division's Tactical World-Wide Web (TACWEB) exploits emerging Internet technologies to provide an effective information management system on the battlefield. Using dynamic web pages and an easy-to-use interface, TACWEB provides a near real-time picture of the battlefield that allows commanders to focus on critical issues and made decisions faster than the enemy. Fusing real-time commander's situation reports and intelligence and then broadcasting this information throughout the division to key leaders, this enhanced command and control capability provides a decisive combat multiplier that will help the United States win the next war – the war for information.

Introduction

The Problem

The 2nd Infantry Division (2ID) had an information management problem. Faced with one-year tours, an extremely high operations tempo, and the 4th largest army in the world only 15 miles away, the young soldiers assigned to 2ID could not effectively use the Army's tactical command and control system, the Maneuver Control System (MCS). Despite the division running a one-week formal training course constantly, operators could pass text messages between tactical operations center at best. The software was too complex for the average soldier to understand. The hardware was specialized and few soldiers could troubleshoot or correct even simple hardware problems. Finally, the hardware requirements of the UNIX-based software limited the number of workstations within the division. There was no redundancy available and if a critical site lost its MCS, that site would be down until the remaining MCS terminals could be reallocated within the division. This reallocation would clearly be difficult under wartime conditions. What 2ID needed a simple, easy-to-use software package that enhanced operational awareness between the division TOCs and major subordinate commands and ran on a common and widely available hardware platform. Unfortunately, such a system did not exist.

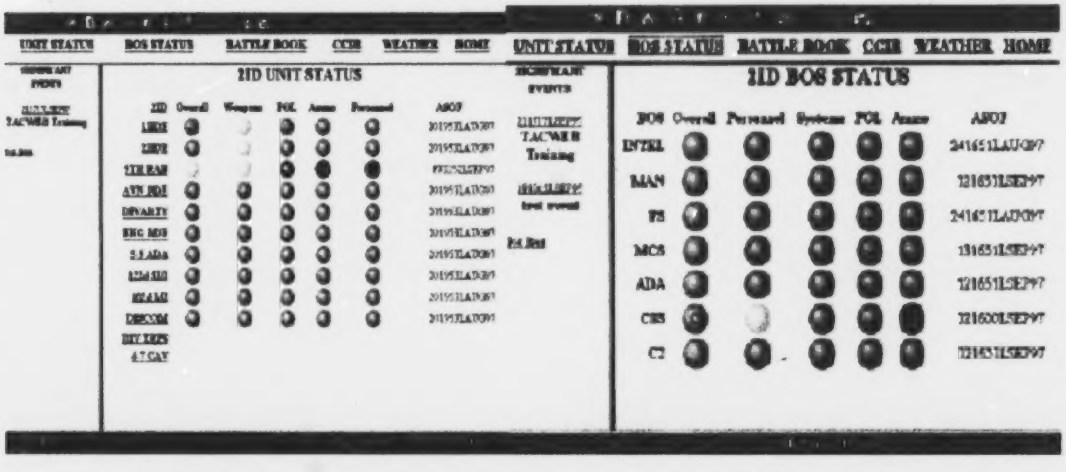

Figure 1: Views of TACWEB: (a) Unit Status Report and (b) BOS Status Report

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The Solution

As a result of these problems with MCS, 2ID developed the 2ID Tactical World-Wide Web (TACWEB) (See Figure 1). TACWEB is a simple, easy-to-use classified, tactical information management system that tracks the battle status of units, battlefield operating systems and other key information such as significant events, commander situation reports, weather, priority information reports, personnel status reports, and logistics status reports. TACWEB minimizes network bandwidth requirements to be highly effective over the Army's tactical communications system, the Mobile Subscriber Equipment (MSE). TACWEB provides an effective information management system that quickly focuses leaders on issues and provides a degree of synergy previously unseen. It is a combat multiplier.

2ID TACWEB

Design Principles

TACWEB was developed using the following design principles:

- TACWEB must present information with increasing levels of detail.
- TACWEB must be easy to use.
- TACWEB must run on commercial, off-the-shelf, hardware and software that is relatively inexpensive.
- TACWEB must run effectively over MSE.

Increasing Levels of Details

TACWEB is first and foremost an information management system. It displays the current status of units and battlefield operating systems in an easy to understand format of automated, color-coded heads-up displays (HUDs). All of these displays are dynamic WWW pages – WWW pages that are dynamically built using the latest information from tactical databases. These HUDs are the gateway to additional information and consist of a series of color-coded "gumballs" (See Figure 1). Each gumball is green, amber, red, black or white depending on status. If the user moves the mouse over a gumball, a comment field automatically appears, superimposed over the HUD, with additional information on the gumball selected. By convention, all amber and red gumballs have comments. Those green gumballs that have comments have a "C" centered in the middle of the gumball. This indicates that while the system being reported is green, the commander or staff element has provided a

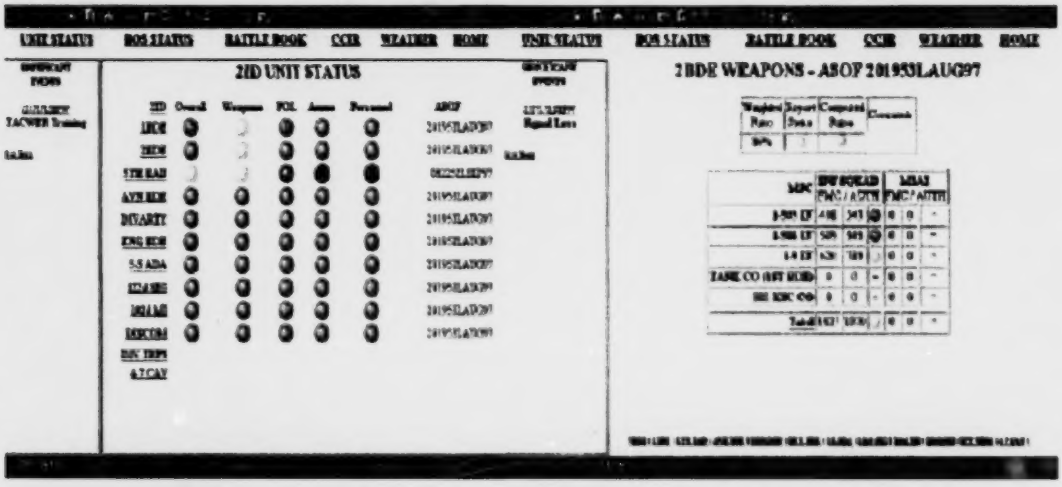

Figure 2: (a) Normal Unit Status, (b) Detailed Weapons Status of 2nd Brigade

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comment that requires division command group attention. If the user desires more information, he or she need only click on the gumball to load an additional page that provides another level of detail (See Figure 2). Each gumball is linked to a different report depending on the topic. For example, the division commander reviews the Unit Status Report and notices the 1st Brigade is amber in weapons system. He moves the mouse over the amber gumball and automatically the commander's assessment of weapons status becomes visible as a superimposed text box from the latest commander's situation report. If the division commander requires additional information, he then clicks on the gumball to bring up a complete, color-coded display of the weapons status of the brigade with the number of operational weapons of each subordinate battalion as well as a total weapons summary of the brigade. Additional weapon status reports provide automatic totals of weapon systems across the entire division (See Figure 3). Thus, users can control the amount of detail visible, from division to battalion level, so as to have the right amount of information to make decisions.

Easy to Use

TACWEB is easy to use. Users submit information through a fill-in-the-blank Common Gateway Interface (CGI) form running on TACWEB. Users simply fill in the appropriate form for a report and click on a submit button (See Figure 3). The information is transmitted as ASCII text over the MSE network to the TACWEB server where it is automatically added to the Division's database. When users submit an updated report, all of the information from a previous report is automatically loaded so that the user need only make the necessary changes to submit an updated report. Users can be trained to submit TACWEB reports in less than 15 minutes and to fully utilize the informational resources of TACWEB in less than four hours. Compared to MCS, it is a very easy system to use.

From the commander's perspective, TACWEB is likewise very easy to use. The divisional database takes the data provided by users and automatically transforms it into a series of automated HUDs that track critical battlefield information. Commander's can quickly and visually assess the status of units and BOS without reading mountains of reports. Critical information is automatically updated at set intervals so that commanders and the division staff always have the latest information to make decisions. As commander's situation reports are received, the division staff can provide comments, linked to the situation report, with ongoing efforts to resolve issues. It quickly becomes clear what issues are being resolved and what issues have somehow been lost. With automated updates and color-coded displays, the division command group can quickly assess the status of the division and focus on those critical issues that make a difference.

The synergistic impact of this automated, real-time information fusion cannot be understated. Issues are immediately apparent. Disconnects between staff and units are likewise apparent. TACWEB users can easily assess the status of the entire division in but a single moment. TACWEB even synchronizes all of the computers accessing the server so that everyone is using the same current time. Everyone is working using the same, nearly real-time information.

Finally, TACWEB is easy to customize to fit rapidly changing conditions. The G3 can easily task organize the division and then change the task organization in the middle of an operation to meet operational requirements. The changes are immediately visible to all units. The TACWEB task organization tool also allows other units to easy use and exploit TACWEB. It is not coded so as to work only with 2ID but instead is written to work with any unit. The 82nd Airborne Division or 3rd Corps could easily install and operate the software without modifying the TACWEB software. Likewise, the G3 can easily change pacing items and weapon systems and those changes are immediately reflected on unit commander situation reports and logistics status reports. This provides the division command group the ability to track critical equipment and change what the critical equipment is as the battle progresses. For example, as the division fights defensive operations and then transitions into a counterattack and river crossing, the pacing items for subordinate units can change.

Hardware and Software Requirements

TACWEB requires a personal computer capable of running the Microsoft Windows 95 or NT operating system and Internet Explorer 3.02 or higher WWW browser. It performs best on Internet Explorer 4.0. There are an

adequate number of computers within 2ID capable of meeting the hardware requirements and Internet Explorer 4.0 is a free software package. As such, the hardware and software requirements of TACWEB are minimal compared to MCS.

Effective Over MSE

To be useful, TACWEB must be effective over MSE. TACWEB reports are small ASCII text transfers and as such, require limited bandwidth. The largest TACWEB report, the unit LOGSAT which is only submitted twice per day, is less than 60 kilobytes in size and most TACWEB reports are much smaller in size.

The TACWEB interface is spartan yet functional in appearance. Graphics are strictly minimized to limit network load. With the exception of the four small gumballs (green, amber, red, and black) each of which is less than 5k in size and each of which only have to be loaded once, there are no graphics in 2ID TACWEB. Every other component is HTML code, which is transmitted as ASCII text. There are no Microsoft Word documents, Excel spreadsheets, or PowerPoint slideshows. In fact, the bandwidth constraints are so low that users with STU-III telephones and the Windows NT operating system can dial in to the system and access TACWEB information. TACWEB is effective in low-bandwidth systems.

Once loaded, the information displayed is static and does require any network resources with two exceptions: the significant events frame and the marquee line update every two and five minutes respectively. Otherwise, the user must refresh the pages as needed. As a result, TACWEB places an extremely limited network load over the MSE network while providing a highly effective information system.

Lessons Learned

2ID implemented TACWEB prior to and during Ulchi Focus Lens, a major Korean simulations exercise. It was immediately successful and received command emphasis as the command group exploited the potential of TACWEB. It was also used during the next divisional exercise, WarPath II which is the division rehearsal for its WarFighter exercise. From the communicator/ automator perspective, sensitivity to network outages and especially outages of the tactical packet network increased as TACWEB gained increased importance within the division. The Division Command Group perceived TACWEB as a real-time reporting system. Outages were immediately noticed and resolution of outages received increased visibility. Techniques such as dual homing of tactical data switches and increasing bandwidth available took on added significance. Switch operators had to adjust to this heightened sensitivity and aggressively monitor the tactical packet network. System Control

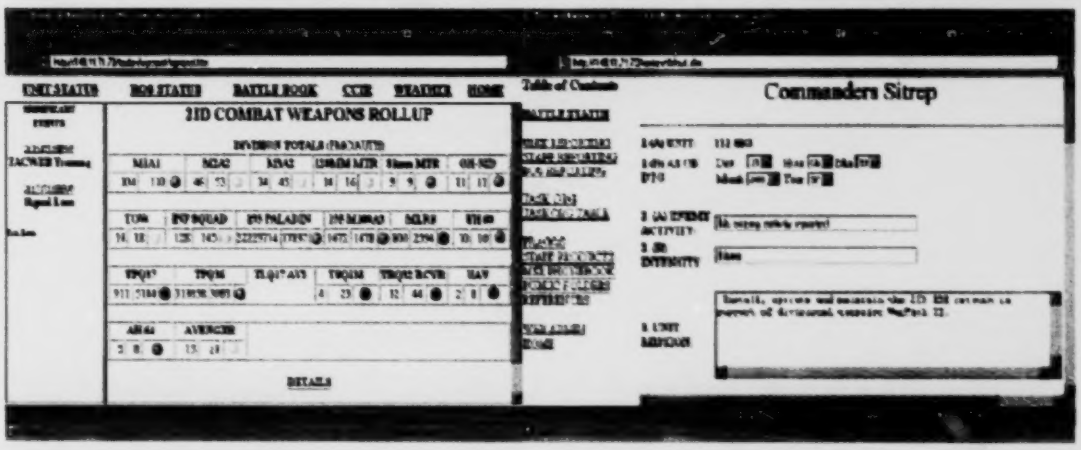

Figure 3: (a) Division Weapons Rollup and (b) Submitting a Commander's Situation Report

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likewise became very sensitive to the data network. Data, not voice trunks, became the benchmark of the MSE network. This was a fundamental shift for 2ID.

While the first exercise, Ulchi Focus Lens demonstrated the potential of TACWEB, the WarPath II exercise validated this perceived potential. The division staff and subordinate units accessed TACWEB over 400,000 times in a five day exercise and downloaded over 3.6 gigabytes of information. The average access time was approximately 4.5 seconds. TACWEB was fast and useful and as a result, units used it extensively. The success of TACWEB has continued and it has been used extensively during numerous exercises such as WarFighter, Iron WarSteed, Strike WarSteed, and WarStrike.

Numerous exercise examples illustrate the functionality of TACWEB. Twice during the commanding general's morning update, the status of units changed rapidly during the brief and division command group had the necessary information to make immediate decisions based on accurate, real-time information of all major subordinate commands. Without TACWEB, this synergistic view of the battlefield would not have been possible and the division would not have been able to react to rapidly evolving situations. External evaluators confirmed what everyone on division staff already knew: TACWEB was a combat multiplier.

The synergistic view provided by TACWEB also facilitated rapid and accurate parallel planning process. Because everyone knew the real-time status of divisional units down to how many tanks and APCs were available in each unit, units and staff elements could anticipate future operations and begin parallel planning. This was especially apparent to the Aviation Brigade and Division Artillery brigade commanders who are adept at using the TACWEB.

Finally, the linking of unit statuses with staff assessments and comments also proved to be invaluable in synchronizing staff actions to address statuses. Everyone had visibility of divisional efforts to address personnel and equipment shortcomings. The G1, G3, and G4 aggressively tracked unit statuses and responded to unit issues in a manner that had previously been impossible.

TACWEB Limitations

While TACWEB is an effective information management system, it does have certain limitations including:

- TACWEB is only visible to units with MSE switch support.
- Information security of TACWEB.
- Limitations of WWW technology.

TACWEB and MSE

TACWEB utilizes the MSE data network as its transport mechanism. As such, TACWEB is currently only visible to units with dedicated Small or Large Extension Node (SEN or LEN) support. Battalions internal to a brigade do not have access to TACWEB and as a result cannot submit reports over TACWEB or receive information. While this limits the effectiveness of TACWEB, it also limits the potential for compromise of the TACWEB system. Other units in the Army face the same problem. As solutions such as the Surrogate Digital Radio are tested and validated as part of the Advanced WarFighter Experiment, 2ID will adapt these technologies to expand TACWEB to battalion level.

Information Security

TACWEB provides excellent internal information security. An easy-to-use security interface allows web administrators the capability to set permissions by staff section and unit. These permissions address all possible actions on the TACWEB site except viewing. This lack of protection against viewing pages is a fundamental weakness of the system. If the enemy gains access to the system through the MSE network, the entire divisional

status is available. While this is unlikely, future revisions to the TACWEB software will address these security concerns through initial and periodic authentication requests.

Limitations of WWW Technology

While WWW technology is constantly improving, there are significant limitations in the underlying technology. The WWW does not support the easy presentation of briefing material in a format similar to dedicated presentation software such as PowerPoint or Harvard Graphics. Overlaying graphics to form complex presentations is simple in presentation software and very difficult with the WWW's language, the Hypertext Markup Language (HTML). As a result, users have false expectations on the ease of generating dynamic informational displays over the WWW. For example, forming a terrain map with unit locations overlaid is extremely difficult and requires the developed of a specialized and complex JAVA applet where it is a relatively simple task in PowerPoint. Moreover, the WWW was developed for the efficient presentation of relatively static information and not the presentation of real-time information over low-bandwidth networks in a tactical environment. These limitations hinder the potential of TACWEB to replace other tactical information management systems.

Further Development

Additional development of TACWEB is focused on:

- Enhancing the operational security of TACWEB. TACWEB makes it too easy to compromise the status of all divisional units. Additional security measures are necessary.
- Migrating TACWEB to other Army and Department of Defense units.

Conclusions

TACWEB is a highly effective tactical information management system. It has fundamentally changed how the 2nd Infantry Division uses information and automation systems to form a coherent picture of the battlefield. It allows the commander the ability to make decisions faster based on more timely information and thus stay inside the enemy commander's decision cycle. It is an easy-to-use combat multiplier that one day will save the lives of soldiers on the battlefield.

Time for Hypervideo on the Web

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Abstract: Hypermedia has proven to be a powerful way to structure and interact with multimedia information. True integration of video in hypermedia documents requires a more powerful model, defining the semantic of linking to other videos or other media, and taking into account its spatial and temporal dimensions. In this paper, we propose a model and tools for dynamic information hyperlinking or hypervideo support on the Web.

1. Introduction

Hypermedia has proven to be a powerful way to structure and interact with multimedia information. Compared to other media, video has some unique characteristics that make it more rich and interesting, and yet more complex to handle [Elmagarmid 97, Hampapur 95]. While its richness suggests the use of a powerful structuring paradigm, its complexity makes the task more challenging. This challenge becomes more relevant, as technology is making video more easy to access, store and transmit. Also, the new tendencies for media convergence and integration are transforming video into a dominant medium.

Hypervideo refers to the integration of video in hypermedia documents. So far, on the Web and almost every hypermedia system, when supported, video could only be manipulated in a way similar to a VCR, with controls to run, stop and pause, and links could only be made to or from video as a whole. True integration of video requires a more powerful hypermedia model, defining the semantic of linking to other videos or other media, and taking into account its spatial and temporal dimensions. In this paper, we propose a model and tools for dynamic information hyperlinking or hypervideo support on the Web.

2. Design Principles

The video hypermedia mechanisms should be integrated in the Web according to some design principles: a model should be defined, as an extension of the hypermedia model used in the Web and based on HTML, thus providing for a smooth paradigm integration; Supporting tools and mechanisms should provide easy production and use of hypervideo documents, and backward compatibility with existing Web documents; A model for hypervideo on the Web should take into consideration the specific properties of video information, such as its dynamic nature and the narrative process that is usually employed. Aesthetic and rhetoric properties must be taken into account, so that the resulting documents allow taking full advantage of each of the involved media [Liestøl 94, Sawhney 96]. These are essentially to be considered in the authoring process, but the underlying tools should support it.

3. Hypervideo Model

In our model, links can be established between any type of media and, like any link in HTML, are unidirectional and defined at the origin. From video, space and time conditions can be defined to restrict links scope. Therefore, links can be spatial, temporal, spatio-temporal, or unconditional. The latter meaning they are always active, from anywhere on the video. When links have video as a destination, they can specify a time interval for the target sub-video. Both interval limits are optional, having the beginning and end of the video as its default values. In the current prototype, active links or hot spots representation for the new links is similar to the one browsers use for other links. Examples of this are: (1) status message with link information, when cursor moves over an active link; (2) and border color change for the video, as is usual for images, but which can change

with time, reflecting the existence of active links at different moments. In the future, we intend to explore richer solutions concerning video hotspots representation, in order to provide better indications about the link existence and destination. As for navigation, and besides from the follow link facility, a history mechanism with back and forward operations is provided for the new types of link.

4. Implementation

To support the model described above, extensions were made to the A, AREA and MAP elements, through the inclusion of new attributes. These refer essentially to the type of link and temporal information, mentioned in the description of the model. Maps provide the support for the spatial nature of the images, to which they can be associated, and were used in a similar way for spatial hyperlinking in video. For spatio-temporal hyperlinking: (1) the MAP element is extended to consider time, the period in which the map is active for the video it is associated with; (2) a list of maps can be associated with each video, because spatial characteristics change with time. All these extensions are supported by a set of scripts that are generic, reusable, and almost transparent to the author of the hyperdocument, except for the inclusion of an extra line in the header. The authoring process is done in a declarative way in "extended" HTML. The current prototype is based on Dynamic HTML and uses VBScript language and ActiveMovie technology [Simpson 97].

5. Related Work

Other approaches to the integration of video with other media in different environments have been described [Correia 97, Liestøl 94, Sawhney 96], but they refer to proprietary applications. A language for the integration of multimedia objects into synchronized presentations in the Web was recently proposed [W3C 98] and the specification is in progress.

6. Results and Future Work

These tools are being tested and validated in a project, UNIBASE, on interactive multimedia for open and distance learning, where video plays a central role. We are working on its tuning and extension. Main issues concern: the usability of the system; the support for the authoring of hypervideo documents, including the application of video processing techniques [Correia 96, Elmagarmid 97] to index and annotate video, in order to help and find the anchors for which to establish links; and full support for the functionality found useful and adequate for the integration of different media and interaction modes, to accommodate different styles of learning.

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JAVA Technology and Its Applications in Teaching

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Abstract: The ease of learning Java, its reliability, and its portability make this programming language more and more popular among students and faculty. It has gained much attention through its power of multithreading, networking, and computer graphics. Java is publicly available for everybody (it is free). As an assistant in classroom teaching, Java has the flexibility needed to develop classroom demonstrations, web-based databases and Internet enabled client-server applications. The objective of this paper is to present several projects used in classroom teaching. The projects include:

1. Interactive JAVA Project to Demonstrate Mathematical Concepts

In this project, Java is used to develop the graphic user interface such as menu bars, buttons, and frames. Geometric concepts such as lines and planes are also presented by using Java. Java is good at providing interaction, so that a student is able to use the mouse and keyboard to participate in hands-on activities with math objects through the World Wide Web. Java can also provide sounds and images to go along with the math learning process, which makes the learning of math more lively and interesting.

Among the Java projects we have developed, Visualization of Least Squares' Principle is the one that has been used in the Linear Algebra class. A least-squares problem is to find a vector of coefficients $\underline{x}$ so that the error $\underline{\gamma} = A\underline{x} - \underline{y}$ is minimized where A is an m x n matrix. In the case that m = 3 and n = 2, A $\underline{x}$ is a vector that is in the column space of A and the column space is a plane in $\mathbf{R}^3$. By the geometry interpretation, the $\underline{y}$ is a vector that is not in the column space of A. Thus, a way of looking at the least-squares principle geometrically is to minimize the length of the error vector $\underline{\gamma}$. This can be achieved by choosing vector $\underline{\gamma}$ such that $\underline{\gamma}$ is orthogonal to the column space of A. By tacking the advantage of the Java's capability on handling computer graphics, the vectors $\underline{x}$, $\underline{y}$, $\underline{\gamma}$ and the column space of A can all be painted on an Java applet. To make this Java project interactive, the connection point of the vector $\underline{\gamma}$ and the projection of the vector $\underline{y}$, the vector p, can be dragged around on the column space plane by using a mouse. As the mouse moves around, the length of the vector $\underline{\gamma}$ and the angle between the vector $\underline{\gamma}$ and the vector $\underline{p}$ are calculated and are displaced on a Java applet. In such a way, students can visualize the relation between the projection angle and the length of the error vector $\underline{\gamma}$. A graphical user interface is also developed so that students can choose various projects from the menu bar.

2. World Wide Web Database Project with JAVA

Database development is one of the key courses in a computer science or information systems curriculum. Connecting to databases from the World Wide Web enhances learning and teaching. Students will be allowed to develop, modify, discuss and submit database projects over the Internet. With the Java interface, the Web-based database projects allow interactivity by providing a graphical user interface. Through the graphical user interface, students can test their SQL queries, add and delete records in a database table, and search for specific records in a database. By using the Web database, students are able to develop applications such as online shopping systems, online registration and discussion, tracking stocks online, and many other Internet applications.

One of the projects we have used in teaching Corporate Intranet Development class is the Company's Sales Information database. The database contains information such as products, descriptions, costs, units sold and etc. The database is developed by using Microsoft Access. To run the database on the company's Intranet or World wide Web, the Access ODBC is installed on the Web server. The Java program instantiates the JDBC/ODBC driver which is used to query the database. The Java program also provide the graphical user interface with the textfields, panels, and buttons. With these panels and buttons, a student can select a specific database to work with. Over the Intranet or World Wide Web, students can view and search the database, add or delete a salesperson's record, modify a field, such as the field of working hours, and redesign a table interactively. Students can even test a query for a selected database on Web. Once their work is completed, students can submit their homework through the Internet.

3. Real World applications

Java programs are not only a great convenience as teaching tools, they also provide the first hand experience on developing real world projects. Nowadays, as the Web becomes a more and more important tool for doing business, the work that students have done by applying Java in problem solving processes makes them ready for Web related jobs. Helping students prepare for real world jobs is part of the goal of classroom teaching. Java is an ever more popular vehicle for achieving this goal. Many students have developed various real world Java-based applications. The education majors have developed Java projects such as English-Arabic Dictionary and math learning tools for the Algebra I class. In the English-Arabic Dictionary project, an English word is represented by an icon. Once the icon is clicked, both

English and Arabic pronunciation are given. It is a great tool for those who want to learn foreign languages. In the math learning project, algebra equations with various colors flying around on a computer screen, a student uses a mouse to catch the equations. once an equation is caught, the student has 1 minute to solve the equation. If the answer is right, the student is awarded with higher score and music. The projects developed by the business majors are as good. They have developed projects such as dynamic stock watch which gives stock figures and charts instantly. The graphical user interface allows the user to choose stocks. Among other business applications, pizza delivery system is the interesting one. It has a city map on the pizza ordering applet. When a customer clicks the street where he/she lives, the street information is passed to the pizza delivery person, so the person will know how to find the customer.

Java's portability makes it an ideal tool for implementing a client-server system over the World Wide Web. Once Java programs are developed on one platform (such as Microsoft Windows NT on a PC) and then they can be run on many other platforms (such as Macintosh, Sun Workstation with Solaris) without modification. Java's applets can be included in the instructional materials. They can also be downloaded from the instructor's server to the students' home computer. It does not require students to have a specific platform on their home computers. Even if a browser is not suitable for hosting the instructional materials, the student can still run Java applets by downloading and using a free Java Development Kit package to run them. The main attraction of Java-based teaching materials is its ability to build executable content into the instruction materials, so that students can conduct their own experiments over the World Wide Web. Java has provided a bridge between faculty and students. It makes faculty more available to students. The interactive and dynamic learning materials implemented by using java applets will make the distance learning easier.

An Exploration Of Web Users' Internal Experiences: Application Of The Experience Sampling Method To The Web Environment

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Abstract: In this paper we report our investigation of Web users' internal experiences by employing a digital implementation of the Experience Sampling Method (ESM) to elicit Web users' hidden experience. The computer application we created, functionally equivalent to the ESM, allows us to capture users' situated perceptions and internal experiences at given moments. How we transformed the ESM for the Web environment is reviewed and what we have learned from our data analysis and our approach is discussed.

1. Introduction

Human beings' experience can be divided into two aspects: external behavior and internal behavior. The external aspect of experience refers to how a person at a certain time, in a certain place engages in activities, encounters people or faces some situation. Internal behavior refers to how a person feels and thinks during specific moments in his perception of self and the world. The experience of "being" in the world helps a human being build him or her "self" through the interaction of the aspects.

As computers and networking technology increasingly penetrate our daily lives, a study exploring human beings' experiences becomes more and more important for at least two reasons. First, the information technology provides human beings with an unprecedented opportunity for distributed communication. Indeed, the growth of interactions on the Internet indicates that people are taking advantage of these opportunities. Communicating in a distributed environment itself probably generates some unique experiences. Second, human beings now live in an information-intensive world which creates some impacts on human beings' experiences. We believe there is an emerging need for an in-depth exploration of human beings' experiences in this "information age."

Over the past several decades, either quantitatively or qualitatively, social science researchers have tried in labs or in the field to observe and analyze human beings' internal and external experiences. Potentially understanding human beings' experiences can provide us with more knowledge about ourselves as human beings and can inform us about how to effectively employ emerging technologies. To understand human beings' internal and external experiences, different research methods and observing schemes have been developed. Depending upon one's orientation, quantitative measurement may be seen as an appropriate tool in measuring external experience and qualitative research methods may be a better idea for studying internal experience. However, some behaviors (particularly internal) have not been effectively observed, some of these behaviors are not available for analysis and replication or are not suitable for systematic analysis. For these situations, traditional research methods may not provide researchers with reliable and valid data for their studies.

There are a few concerns about measuring internal experience in daily life. First, in general, measuring the same individual repeatedly at different times or occasions may provide the optimal approach to studying experience [Stone & Kessler & Haythornthwatt 1991] [Wheeler & Reis 1991]. The quality of the data and the amount of information in a single questionnaire may not provide enough data for researchers to explore

subjects' inner world over time. Second, data collected over extended time periods are subject to substantial distortion, especially it is the inner experience in question. Several studies have already demonstrated that recall accuracy decreases linearly over time [Conrath & Higgins & McClean 1983] [Bernard & Killworth 1977] [Bernard & Killworth & Sailer 1982]. Therefore, the data point measured should be as close as possible to the occurred event in question. Third, in order to study internal experience in its naturalistic environment, for the purpose of ecological validity, the measurement of internal experience should occur in actual situations and in the natural environment, not in laboratory setting. Fourth, internal experience in daily life is a completely subjective inner experience situated in different time and place and is not directly observable without further inquiring respondents directly by using questionnaires or self-recording techniques. Therefore, needed is the research method of self-recording, which requires subjects to introspect and monitor their inner and external experience through self-reporting instruments.

In this paper we investigated users' internal (or perceived) experiences in the Web environment. We employed a digital implementation of the Experience Sampling Method (ESM) [Larson & Csikszentmihalyi 1983] to elicit Web users' internal and external experiences while engaged with the Web. In the following sections, we will first introduce the ESM and its functions, and then discuss how we transformed the ESM for the Web environment by creating an "auto-ask" application. In the last section we will discuss what we have learned from our data analysis and our approach.

2. The Experience Sampling Method

The purpose of the Experience Sampling Method (ESM) is to capture the main dimensions of consciousness. It has been more than two decades since the ESM was developed at the University of Chicago in 1976 [Csikszentmihalyi & Larson & Prescott 1977]. The original format of the ESM consisted of providing respondents with an electronic pager and a questionnaire booklet. The researchers randomly activated the pagers several times a day. Upon receiving a signal on his pager, the respondent would fill out one sheet of the booklet. By the end of the study, usually lasting from one to several weeks, the booklet contained a systematic description of the person's life in different situational contexts at different given moments, including external experiences and internal experiences. The external experiences might have included the activities performed, places visited, people encountered at given moments. The internal experiences might have included perceptions when the signal activated, such as emotions, cognitive efficiency, motivational states, challenges encountered and skills brought to the situation [Csikszentmihalyi & Csikszentmihalyi 1988].

There are a few reasons that make the ESM an appropriate and useful tool. First, the randomness of signals sent out from the researcher to subjects' pagers over time makes the random sampling of subjects' experiences possible. Second, the ESM is a general-purpose research tool which is not limited to any specific research question or domain. It can be used to diagnose a wide variety of topics by redesigning the self-report booklet appropriately [Kubey & Larson & Csikszentmihalyi 1996]. Third, the richness of the data collected from subjects tells researchers at given moments what respondents' internal and external experiences are. Researchers can then reconstruct the situational context at every given moment and diagnose the situation. Fourth, the ESM creates an opportunity to overcome constraints of other methods by "combining the ecological validity of field methods with a variety of measurement techniques" [Kubey & Larson & Csikszentmihalyi 1996]. Fifth, the ESM can provide highly detailed insight into changes in perceptions in everyday life. Since an ESM study usually lasts from one week to a few weeks, it becomes possible to diagnose changes over time.

For years, various versions of the self-report booklet were developed and several different types of signaling equipment were employed, such as programmable watches and laptop computers. Originally, the ESM was developed for the purpose of studying the concept of "flow" [Csikszentmihalyi 1975] in the field of psychology but more recently this method has been accepted by researchers in diverse fields, such as geography, sociology, education and communication. As a general research tool, the ESM has been employed to study different research topics, such as thought content, cognitive disorders, emotional experience, self-image and self-awareness, adjustment to change in drug use and rehabilitation, and the behavior of gifted children or disabled children.

3. Exploring Web Users' Internal Experiences

How is the ESM useful to scholars interested in Web phenomena? Why should scholars interested in Web phenomena be concerned with this particular method? The advantage of the ESM is that it provides a systematic examination of subjects' internal experiences over time. The concept of internal experiences applied to Web navigation refers to a Web user's overall subjective feelings during interactions within a distributed, multi-media environment. An individual's subjective experience in a Web environment is usually bounded by specific points in time, in a specific place, i.e., the experiences are "situated." Therefore, to tap dimensions of Web users' internal experiences, it is important to focus on the users' inner experiences situated in the behavior of Web navigation.

Traditional research methods, such as interviewing or surveying, have been a useful tool when a researcher tries to diagnose a subjective dimension of experience from subjects' memory. However, when a researcher wants to elicit a sequence of events relying on subjects' memory, the results may not be satisfactory due to three reasons. First, memory is not exact and recall may not be complete; respondents may not remember. Second, by reconstructing the events and consciousness through recall, subjects may not be able to put themselves into the same situational context where the events actually occurred. Third, it becomes difficult for subjects to separate between actual event as it occurred in a situational context and the personal wishes or social expectancy that may influence its retelling [Csikszentmihalyi & Csikszentmihalyi, 1988]. The problems with interview and questionnaire data collected outside the context in they were experienced have been long known for their validity problems.

With these methodological constraints, we argue that traditional approaches which study objective, external concepts or demographic variables are not appropriate for internal, situated behaviors [Dervin 1983] [Dervin & Nilan 1986]. We need a better observation tool which would allow us to see how users perceive and construct their personal experiences in a situational context and how they build their pictures of reality during their Web navigation process. In our study of Web users' perceived experiences, we argue that the ESM would be an appropriate research tool.

4. Auto-ask and Our Study

To apply the ESM in the Web environment, we needed an application which could record users' navigation activities, such as the time of the movement between Web pages, titles of Web pages and the URLs of visited pages. Information about users' navigation activities allows us later to track users' interactivity within the Web environment. Like the ESM, the application we created is able to activate a questionnaire according to a random schedule, popping up on the computer screen on the top of users' Web browsers to capture their situated perceptions. Each time that the questionnaire is activated, the respondent fills out the questionnaire based upon the situational context. The questionnaire was designed to elicit users' dimensions with open-ended items as well as eleven-point Likert numerical scales. We call this questionnaire popped up at random interval a "loop," the unit of analysis of this study because it constitutes a situated observation which is repeated several times for a given respondent. The data collected from each loop represents each user's inner experience during specific moments in their Web navigation. By studying these data points for Web users, we can then begin to reveal their inner experiences and the results can help us understand Web users' subjective experiences during the navigation process.

The computer application we created is called "auto-ask" which is functionally equivalent to ESM. It allows us to capture users' perceptions at given moments which are advantageous for two reasons. First, the very randomness of the sampling of users' perceptions during subjects' Web navigation provide results which reveal the general quality of subjects' Web experience and changes over time. We believe this gives us good coverage of the range of users' experiences. Second, by interrupting the subjects' navigation several times, we are able to catch their subjective experience at specific moments, i.e., our observations are situated.

In order to observe users' subjective experience during their Web navigation, we integrated the auto-ask

computer application into the Web environment. Data were collected from 100 individuals in a northeastern university who were using the Web as part of their day-to-day experience. Subjects who were browsing on the Web in the computer clusters during the research period were asked to participate this study. With subjects' consent, the auto-ask ESM software was installed onto subjects' computer and started. Subjects then continued their navigation behavior as usual. Like ESM, the application activated a questionnaire according to a random schedule with a time interval from five to seven minutes. After three loops, subjects could press a button to quit their participation and send the data to researchers through the Internet automatically. A total of 201 loops (n = 201) were collected for this study.

The questionnaire asked about subjects' inner experiences with both open-ended items (e.g., What make you feel challenged?) as well as numerical scales (11-point Likert scales) that indicate the intensity of these dimensions (Where would you place yourself on the following scale for the Web page you were just looking at?). This allowed us to capture users' perceptions at given moments in a situated context of one or more Web pages. The data collected from several loops during users' Web navigation help us understand users' perceived and subjective experiences during their navigation process.

For each loop, we asked the following questions:

1. What is your purpose on the Web right now?
2. Do you know exactly where to go next to get what you want? And what makes you feel this?
3. Were you paying complete attention to the Web page you just visited? What makes you feel this?
4. How would you describe your feeling about time passing? Too slow, O.K. or too fast?
5. How would you describe your orientation to the web page you were just looking at? Interest, fun or curiosity? What make you say this?
6. Do you feel challenged by the Web page you were just looking at? What make you feel this?
7. Do you feel you have adequate skills to deal with the Web pages you were just looking at? What make you feel this?
8. How do you feel (from the Web page you just visited) about the possibility to communicate with the designer of that Web page? What make you feel this?

5. Discussion

This was an exploratory study employing the auto-ask ESM to users in the Web environment. We will summarize our preliminary findings and then we discuss what we have learned from this study.

The data we collected by employing the auto-ask ESM tool to the Web environment is very rich and we can only present very limited results here due to the size limitations. We found out there is a higher proportion of Web surfers than we had expected and their navigation activity usually is not goal directed. In addition, their goals change frequently during their surfing, and sometimes users abandon their original goals and become pure surfers. Since the Web pages provides a very friendly user interface, some subjects reported that they have become lost because Web pages either do not provide clues telling users where they are and where they can go, or the Web pages simply had organization problems. However, most of our subjects believed the Web pages they just visited offered an effective communication channel between Web master and themselves.

In our study, we also try to elicit subjects' internal experiences. For example, most subjects reported that their attentions were focused on the Web itself and extraneous thoughts were screened out completely. Some even reported that time passed faster than they thought in part due to their attentions being focused on the Web. Many subjects reported high levels of enjoyment, fun and interest. However, when subjects were not able to find what they wanted, they began to feel high levels of challenge from the navigation itself. When their confidence levels were high, subjects reported high attention and high enjoyment in their responses.

As discussed above, the auto-ask ESM application allowed us to elicit Web users' experiences at given moments. By popping up a questionnaire window on top of a subject's Web browser, we forced our subjects to stop their navigation behavior and answer the questions regarding their experiences. In general, we think the

auto-ask ESM is applicable to the Web environment. By eliciting subjects' situational contexts and their experiences, we were able to reconstruct subjects' internal and external experiences during their interaction with the Web. By not relying on subjects' recall or the constant intrusion of talk aloud protocols, we believe our data revealed relatively accurate descriptions of users' experiences. By interrupting subjects' navigation behavior both physically and cognitively, we were able to capture subjects' fresh, situated memory at given moments.

However, there are some negative aspects of using this approach. First, some subjects complained that the questionnaire popping up was very annoying and too intrusive. Even though our application had been programmed to minimize the possible intrusion, some subjects felt uncomfortable when they had to stop Web surfing to answer the questionnaire. Second, we also received some negative feedback about the length of questionnaire and the time they needed to spend on answering questions. Third, from a pilot test before this exploratory study, we found out that in general Web users do not have enough patience to read a long explanatory text. This may be due to the impulsive nature of the current Web environment, e.g., intensive interactivity and distributed hyperlinks, which force users to proceed and not to stay at a given spot too long. Thus, we shortened our questions to short sentences. This may have reduced the reliability of the study.

As with other observational tools, the ESM, as well as our auto-ask ESM version of it, has its limitations and is definitely not a panacea. First, it is not conducive to random sampling of respondents. Usually, it is limited to the convenience samples because you need to access to the sample physically before the study can be started. Second, the study usually is restricted to a specific geographical area because the signaling equipment must be physically installed for subjects although our auto-ask version can be deployed over the Web itself. Third, the signaling equipment is considered too instructive to subjects. Fourth, ESM is a good tool for studying some day-to-day experiences and not an appropriate tool for a specific activity with an ephemeral occurrence.

In this paper, we argued that there is a need to explore human beings' external experiences as well as internal experiences in the information age. By employing more traditional research tools which depend solely upon subjects' recall, talk aloud protocols, etc. we believe the essence of subjects' inner experiences is difficult if not impossible to reveal thoroughly. Studying Web users' navigation behavior and surfing experience, we need a better approach which can help us understand users' feelings and thoughts. Therefore, we propose that the ESM can be a more appropriate tool in the Web environment. The exploratory study we described in this paper provides important evidences that the ESM is useful and promising for exploring Web users' perceptions. We would like to take what we have learned at this stage to refine our approach and our auto-ask ESM tool in order to conduct more systematic research in Web environment.

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Fostering Social Interaction in a Shared Semantic Space for Collaborative Learning

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Abstract: Social interaction is an integral part of collaborative learning. In this paper, we introduce StarWalker — a unique 3-dimensional virtual environment for social interaction. Our design explores the notion of discourse-context mutual coupling in order to characterise social interaction in semantically organised virtual environments. Our aim is to support social interaction for collaborative learning.

1. Discourse-Context Coupling

Social interaction is an integral part of collaborative learning. In this paper, we describe our ongoing research in the development of an innovative three-dimensional multiuser virtual environment called StarWalker to facilitate focused and domain-specific social interaction. StarWalker is accessible on the WWW[1].

The notion of discourse-context mutual coupling is a key concept in our design. It highlights the role of a virtual environment as a medium in which discourse is mediated. The design of StarWalker explores the notion of discourse-context mutual coupling in order to characterise focused and domain-specific social interaction in semantically organised virtual environments. Our principal design rationale is that the visualised structure of a subject domain will provide a natural and stimulating context for collaborative learning.

People from distributed places can visit and share the virtual world. They may engage in some in-depth and scholarly conversations with peers on specific topics in the given subject domain. Currently, StarWalker is structured according to a salient semantic structure derived from papers that appeared in the recent three years ACM SIGCHI's conference proceedings. StarWalker enables concurrent visitors to chat with one another.

StarWalker is originated from our work in information visualisation and visual information retrieval, namely the Generalised Similarity Analysis (GSA) framework [Chen, 1998a; Chen 1998b]. The StarWalker virtual environment is expected to provide a means of exploring some fundamental aspects of collaborative learning, such as social construction of knowledge, situated cognition, and a mutual coupling between learners' activities and their meaningful context.

2. Structures of Social Action

As in the real world, social interaction in virtual worlds is influenced by many factors. People's behaviour is often associated with their social, cultural, and historical backgrounds. Subject matters, the medium of communication, and environmental characteristics influence the way people communicate. There are a large number of signals that people can pick up from the immediate environment and organise their course of action accordingly. These cues of a context are known as contextualisation cues [Gumperz 1982]. Social experiences have been studied in terms of frames [Goffman 1974].

We are interested in the mutual coupling between these contextualisation cues and the structure of discourse, and how the design of a virtual environment can take advantage of such mutual connections so as to provide a stimulating environment for collaborative learning. Works in the social construction of knowledge, situated cognition, and the activity theory have all emphasised the mutual connection between social actions and a meaningful context. A grasp of the characteristics of the context is necessary for people to understand and make sense of behaviour and actions of others.

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[1] http://www.brunel.ac.uk/~cssrccc2/vrml2/starwalker/

Dourish and Chalmers have classified information navigation into three distinct types: spatial navigation, semantic navigation, and social navigation [Dourish & Chalmers 1994]. For example, the social navigation may include information seeking by following the clustering of like-minded individuals in a spatial framework. However, the link between the discourse and context in virtual environments is yet to be fully understood.

Our ongoing work aims to explore the possibility of combining social clustering and semantic clustering within the same environment so that the connected clustering process will reinforce each other and lead to high-quality and focused conversation regarding a specific subject domain. We are starting to observe and analyse the structure of discourse taking place in StarWalker and to study empirical evidence that the structure of discourse is in fact shaped by the visualised semantic structure in the background.

In our work, a semantic space is visualised and rendered in Virtual Reality Modelling Language (VRML). The semantic space is constructed based on a galaxy model. The semantic space is embedded into a 3-dimensional multi-user virtual environment. Users are able to share the visualised domain structure, to communicate and engage in social activities within the virtual environment. The affordances of the virtual world are partially reflected in its name — StarWalker.

3. Ongoing Work and the Future

We expect that the knowledge structures of concurrent users may converge over a period of extensive use of the virtual environment, and that their discourse structures will be strongly influenced by the knowledge structure visualised in the background.

The significance of our approach lies in the tighter coupling between the spatial model of the underlying semantic structure and discourses associated with the virtual environment. Users' navigational behaviour within the spatial framework becomes relevant to the content and the knowledge structure of an underlying information space.

As a result, navigation patterns of a user become meaningful and interpretable with reference to the spatial-semantic relationships. Not only can a visitor make sense of what is happening in a populated virtual environment, but extract contextual and situational cues from others' behaviour and thereby adapt their search and navigation strategies accordingly.

Finally, the significance of the work is due to its unique and profound paradigm of supporting social interactions on the top of a variety of interaction metaphors and enabling techniques, namely information visualisation, information retrieval, virtual reality, and multi-user chat rooms.

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One Hundred Professors' Wish List for an Ideal Web-based Test System

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Abstract: The University of Houston System is working with Anlon Systems Inc. to provide its four campuses with one hundred instructors' accounts to automate the instructional and administrative process for professors. In July, Anlon provided a two-day workshop for about one hundred faculty and staff members from all four U of H campuses who wanted to put instructional materials onto the World Wide Web. During the Q&A session, the instructors expressed the extra features that they would like IntraKal to have. Although these recommendations were made based on the current version of IntraKal, and these improvements may not be technically feasible with today's technology, yet they can well be the features the general school teachers have dreamed of for an ideal Web-based test system. As observers of the collaborative discussion, we have collected a list of their wishes.

Introduction

The University of Houston System is Texas' largest metropolitan university. It is composed of four major campuses, including University Park, Downtown, Clear Lake, and Victoria. Information technology requirements and capabilities vary widely. Some of the faculty has access to the cutting edge resources of electronic classrooms, while others have only passing acquaintance with computer word processors and e-mail. The World Wide Web is fast becoming a technological equalizer between these two extremes. Web-based education is made easier on the four campuses thanks to a pervasive network infrastructure and a well-developed IntraKal Web-based course system (http://www.courses.uh.edu). Faculty and staff may create Web pages for themselves, their courses, their research field, or their departments on the system.

IntraKal is a commercially available academic Intranet package developed by Anlon Systems Inc. (http://www.anlon.com) for colleges and universities. Anlon is working with the U of H system to provide its four campuses with one hundred instructors' accounts to automate the instructional and administrative process for professors and students and increase access to higher education. The package, written in Perl and Javascript, is currently housed at the University Park campus on a Windows NT server with 256 MEG of RAM and 6GIG of hard drive. Each professor is allotted a minimum of 10 MEG of hard disk space.

In early July, Anlon provided a two-day workshop for nearly one hundred faculty and staff members from all four U of H campuses who wanted to place instructional materials onto the World Wide Web. In the workshop, the Anlon representative demonstrated these features that already implemented in IntraKal:

- Online Testing
- Post-test Analysis
- Course Bulletin Board & Chatroom
- Course Material Publishing
- Academic Honest Checking
- Online Calendaring
- E-mail and WWW Connectivity

- Real-time Team Activities
- Real-time Course Grade book
- Online Help
- Search
- Student Activity Summaries

The demonstration was followed by a Question and Answer session, allowing the software company representative and users to communicate and interact. During the Q&A session, the instructors expressed opinions about the extra features that they would like IntraKal to provide. Shortly after, the dialog shifted gear focusing on the Web-based testing feature. The attending faculty vigorously joined in on the brainstorming of what improvement they wanted to see for the IntraKal Web-based testing feature. The Anlon representative dutifully took note of their suggestions, promising to relay the information to the Anlon technical staff. Since Web-based test became the focus of the discussion, the following paper will concentrate on comments and suggestions by the professors and staff for Web-based testing.

People may jokingly say that it is almost impossible for one hundred professors to agree on any specific topic. However, by eagerly participating in the Q&A session, they are endorsing the potential of Web-based test system in the classroom, at least in a higher education environment. Therefore, it was an interesting experience to watch these faculty and staff members contribute on what they wanted out of a Web-based test system. As observers of the collaborative discussion, we have we have collected a list of their wishes.

The Wish List

Support Issues

- Print-based manual, online help, and a 7x24 800 technical support line should be provided.
- Minimum system configurations need to be published online and on documents.
- The system must be accessible to most Internet browsers.
- The Web-based testing system must be accessible at standard Internet connection.
- Instructors need to be able to export their entire courses from the Web.
- The Web-based test should provide documents on how to extract administrative student data and import it.
- The import module for Scantron scoring should be implemented in the Web-based test.

Scoring Issues

- On the electronic answer sheets, the instructor should be able to list keywords in the answers and can enter model response for automatic scoring.
- The instructor should be able to make comments at the beginning, middle, or the end of the student's answers.
- The instructor should be able to leave some questions ungraded or unscored.
- The Web-test should be able to show scores individually and the class as a whole.
- The questions should be able to carry different weights.
- The electronic grade book should provide automatic score analysis features such as standard deviation, class average, etc.
- The electronic grade book should be able to curve scores based on the performance of the whole class. For example, A's for the top 10%, B's for the top 20%, etc.
- The instructor should be able to grade a certain essay question for the whole class all at once so that the scores given will be fair.
- For the electronic grade book, the instructor should be able to assign a grade not taken through the Web-test system.
- The electronic grade book should provide the flexibility of assigning negative scores to accommodate situations such as mandatory attendance.
- The Web-based test system should be able to prepare a list of students who gave the second best answers to a question. These students can then be given partial credits.

- The instructor should be able to import/export the grade book from the Web-based test system to their PCs and vice versa.

Test Creation

- The e-mails sent out to the student's after the test should be able to include test questions, the students' answers, model responses, and instructors' comments, etc.
- The instructor should be able to randomize the test questions, including each individual question and different question banks.
- The instructor should be able to copy questions from the test banks provided by textbook publishers and paste over to the Web-based test template.

Test Management

- Adding students to the system should be easily accomplished.
- Teaching Assistants should be granted limited access to instructors' accounts.
- In the test report, the IP addresses of where the student have taken the Web-test should be listed. If the test is supposed to be taken in the computer lab, any IP address other than the lab addresses should be able to be identified.
- The time spent on the test should be able to be logged. Instructor should receive an e-mail about when each individual question has been answered to see whether the student has spent too much time on a test or a specific question. The instructor can then fairly deduct scores.
- Receipt confirmation messages should be able to be displayed on computer screen and be sent through e-mails to the student after submitting responses.
- If the student attempts to go to another site while taking the test, the Web-test system should be able to block the student out. The block should be released only when the student has obtained the special security reentry password from the instructor with approval.
- The Web-based test should provide side-by-side comparison of students' answers for academic honesty.
- Instructors should be able to terminate student accounts at a predetermined time.

Security Issues

- The Web-based test should provide virus checker to check the answers provided by the students through document attachment.
- The system should zip attachment so that it is not susceptible to virus attack.

Summary

Although these suggestions were made based on the current version of IntraKal, some of them are probably the same as what the general classroom teachers have dreamed of as an ideal Web-based test system. Some of the items on the wish list, especially the ways the faculty have envisioned for creating tests, and the ways they wanted the test to behave, may not be technically feasible with today's technology. However, in a way, by participating in this activity, the involved members are acknowledging the potential of Web-based test system.

Website News: A Website Tracking and Visualization Service

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Website News is a website tracking service. Currently, we track about 20 Internet and telecom companies on a daily basis. A spider wakes up at about 2am every morning to visit these web sites, analyze their html pages, and store the analysis information in a database. A difference database is then created for each website to store the differences between today's version and the last archived version. Another spider collects new links from these difference databases and then prints newspapers for the telecom and Internet industries on a daily basis. Users can also query these databases through a web interface and view the results in HTML or graph views. For more information about Website News and to experiment with the service, visit http://www.research.att.com/~chen/web-demo .

A Survey On Online Education

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Abstract: A survey has been conducted to investigate the current state of online education. About 1,500 websites of 8 different groups were randomly chosen from the Internet for study. It is interesting that the survey result shows that virtual universities, although contribute to a very small portion of the sample data, perform better in many aspects as compared to other groups. In general, the result also indicates that the technology is mature enough for online education and it is the appropriate time for universities to consider offering such courses, but to remain competitive, more need to be done.

1. Introduction

The growth of Internet has been tremendously fast. The use of World Wide Web (WWW) and multimedia technologies on teaching has a great impact on the mode of education [Neilson et al. 1996]. The traditional class room teaching is supplemented by online lecture notes, multimedia animations, and computer simulations [Kann et al. 1997]. More importantly, a new mode of education has evolved which is known as *Online Education*. Roughly speaking, by online education, we mean that the learning material is present on the network and the learner can log on the network at any time to retrieve the material for studying without the presence of the instructor. This mode of education has changed or enhanced the way distance learning courses [Peraya 1994] are delivered. At present, there are already more than 30 virtual universities around the world which offer *online courses* through this mode of education and the number of distance learning courses is expected to increase rapidly [Lewis et al. 1997]. Breaking the barriers of distance and time, online education will become a major mode of education in the future.

The most common way to achieve online education is to make use of WWW. In order to find out the current state of online education, a survey has been conducted on about 1,500 websites which are related to education. Due to the limitation of space, the paper will only give an overview of what has been done. Interested readers, please refer to http://www.cis.hkuspace.org/~olea for a complete set of survey statistics.

2. Sample Data Distribution

About 1,500 sites have been visited. Among these sites, more than a half are universities. Others include online courses provided by individuals and software development organizations (See [Fig. 1] for the distribution). In [Fig. 1], "Univ. (N)" are universities which do not offer online course while "Univ. (O)" are those universities which offer online courses. "Org. (O)" are organisations which provide online courses, "Org. (SW)" are organisations which develop software for online education but do not offer online courses, while "Org. (SWO)" are those organisations which develop software for online education and also offer online courses. The category "Others" refers to the web-sites which are related to online

education but do not belong to any of the other categories, for example, sites providing forums and discussions for online education.

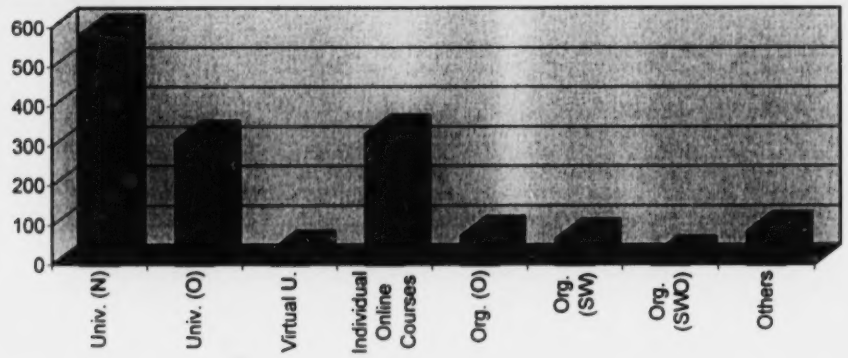

Figure 1: Sample Data Distribution

3. Criteria for Comparisons

In the survey, the sites are evaluated based on some aspects such as overall design, technologies used, and the response speed. Refer to http://www.hkuspace.org/~olea for the set of criteria used in the comparisons.

4. Survey Result and Conclusion

From the survey result, universities which provide online courses show a quite normal distribution with most of them perform moderately in almost all aspects, while virtual universities outperform other universities in some aspects. One reason may be that offering online courses is not the main stream in normal universities. Resources and support may be limited. In other words, if a university wants to offer online courses, and remain competitive, more should be done.

Correlation between different aspects is also investigated in the study. There are some interesting results. For example, both groups of normal universities show a stronger correlation between the overall design and the technology usage than the group of virtual universities. One possible reason may be that in normal universities, website designers are usually technical persons. It is likely that they will try to use more advanced technologies. While this is not the case in virtual universities. However, the exact reasons need further investigation. It is also the appropriate time to investigate other related issues of online education such as the social implication of the online education, the change in roles of the instructors, the cost and resources requirements of running an online course, the alternative way for online education, for example interactive TV. Please refer to http://www.hkuspace.org/~olea for more details about the survey.

5. References

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[Kann et al. 1997] Kann, Charles et al. (1997). Integrating Algorithm Animation into a Learning Environment. *Computers Education*, 28 (4), 223-228.

[Neilson et al. 1996] Neilson, Irene et al. (1996). Education 2000: Implications of W3 Technology. *Computers Education*, 26 (1), 113-122.

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Tracking Web Usage with Network Flight Recorder

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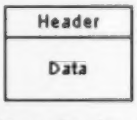
Abstract: The hot topic in security circles these days is Marcus Ranum's Network Flight Recorder,[1] which is normally thought of as a tool to track attempted break-ins. The NFR software is designed to sit on a separate computer from your server and analyze network traffic. Like a flight recorder, NFR survives even if your system doesn't. It can recover or monitor online transaction records, keep historical statistics about how the network grows, and generate detailed breakdowns of how your network services are being used and by whom.

The great strength of NFR lies in its configurability. You can choose to track only HTTP packets, and then you have a tool for validating HTTP log consistency. Because NFR is not connected with your Web server, issues with virtual hosts are easily tracked, and you are not filling up space on your Web server or using valuable CPU cycles for log analysis. Tracking unique IP addresses is more important in Web usage analysis than hit count, and NFR is ideally suited for this. Once you have reached an understanding of potential problems in HTTP serving, it can also serve as a tool for heading off those problems before they cause user complaints.

Sniffers and Security - the design intent behind NFR

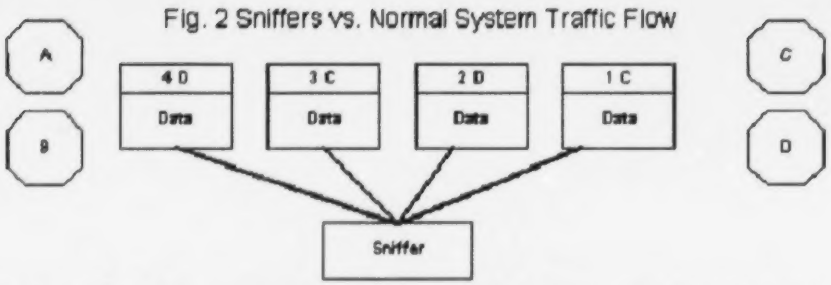
The Internet is based on TCP/IP, which is a packet switching protocol. This means that all data to or from computers on a shared local network go across the same wire, taking turns. Each packet is labeled with a header telling which computer sent the packet and which computer should receive the packet.

Fig. 1 Data Packet



A packet has a header with address information followed by the data.

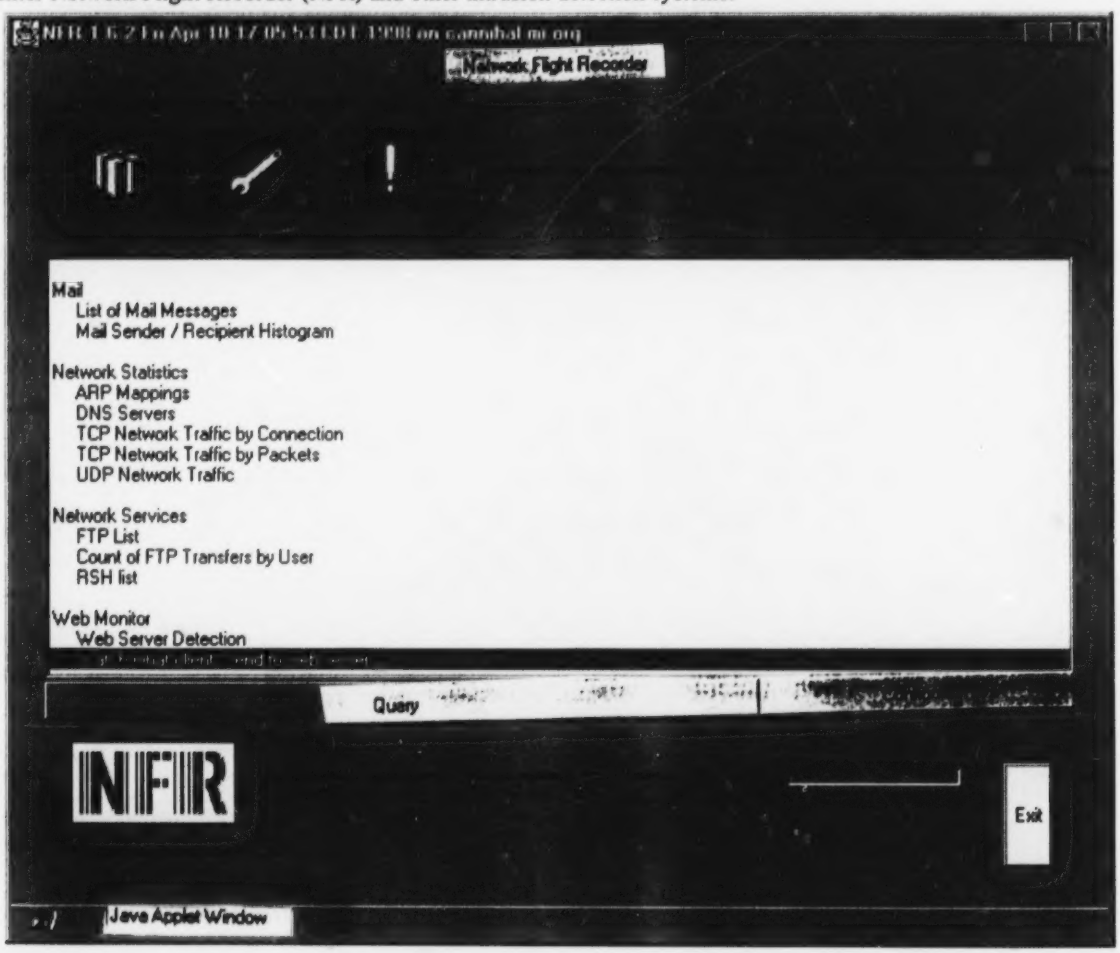
Each computer on a network has a unique address, and the packet switching system permits multiple pairs of computers to communicate across a shared network by dividing each conversation into small packets and arranging for computers to take turns sending packets. Normal IP stacks ignore packets that are not for their address. [2] A network sniffer is a device, hardware or software, that is attached to your network in promiscuous mode, meaning that it keeps track of all the packets going by on the network, not just those with headers saying that they are for it.



Packets 1 and 3 are received by Computer C from Computer A. Packets 2 and 4 are received by Computer D from Computer B. The sniffer reads all 4 packets.

Sniffers were developed to track network problems, and are good for that, but for a long time, network "sniffers" weren't exceptionally helpful to people working with Web servers. You could certainly use tools such as Network General Sniffer [3] or a Unix box running snoop to dump the network data coming along your interface into a file. If you had a good deal of knowledge about how TCP/IP worked, you could stare at data after the fact and make some general determinations about your network. But until recently, it's been very difficult to apply sniffer data toward a particular network protocol, like HTTP or SSL, in any meaningful way. The tools just weren't there, or were prohibitively expensive and complex.

Enter Network Flight Recorder (NFR) and other intrusion detection systems:



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> The NFR uses a promiscuous packet interface to pass visible traffic into an internally meta-programmed decision engine which routes information about packets and their contents into statistical or logging backends. In addition to packet analysis and collection, the NFR's internal architecture permits network managers to sample interesting portions of network traffic for logging or statistical analysis. The NFR programming language is simple, but powerful enough that you can perform reasonable analysis on traffic before choosing to record it. For example, you might analyze SMTP transactions but only choose to record those relating to a user who is sending spam or abusive E-mail. The analysis language includes a capability for generating alert messages which the rest of the system queues, multiplexes, and delivers. A simplified hyper-query interface allows extensive browsing of the NFR's stored datasets and statistics from any Java-enabled browser. [4]

Network Flight Recorder fills an important void in the security tool arena. It is a general purpose network traffic recorder. It is perfect for sites that need to verify their security measures. NFR has a meta-programmed decision engine that is extremely flexible. The NFR N-code language is designed to deal with streams of network traffic, with data types like "source IP address" and "url" along with more general purpose programmatic functions. The NFR inserts your N-code into a high performance filtering engine. For example, one of the simple programs included with NFR is "Watch what clients send to web servers". The user can get different reports by simply filling out an on-screen form, or perform more advanced reporting by changing the N-code. The N-code implementation is shown below.

Figure 4: filter N-code for showing Web client requests

```
#       Copyright(C) 1997 Network Flight Recorder, Inc.
#       All rights reserved.
#
#       Use and distribution of this software and its source code
#       are governed by the terms and conditions of the
#       Network Flight Recorder Software License ("LICENSE.TXT")
#
# By Mark Sienkiewicz / NFR
#

# This filter serves two purposes:  to record client requests
# made to your web servers, and to serve as example in the LISA paper.
#

watchservers_schema = library_schema:new ( 1,
        [ "time", "int", "ip", "ip", "str" ] , scope() );

# list of web servers to watch.  List IP address of servers or a netmask
# that matches all. use 0.0.0.0:0.0.0.0 to match any server

my_web_servers = [ 0.0.0.0:0.0.0.0 ] ;

# gather data the client sends to a web server.  This will only see
# web servers on port 80.  If I had web servers on other ports,
# I would make this more elaborate.  (coming soon?)

filter watch tcp ( client, dport: 80 )
{
        if (! ( tcp.connDst inside my_web_servers) )
                return;
        declare $blob inside tcp.connSym;
        if ($blob == null)
                $blob = tcp.blob;
        else
                $blob = cat ( $blob, tcp.blob );
        while (1 == 1)
                {
                $x = index( $blob, "\n" );
                if ($x < 0)             # break loop if no complete line yet
                        break;
                $t=substr($blob,$x-1,1);        # look for cr at end of line
                if ($t == '\r')
                        $t=substr($blob,0,$x-1);        # tear off line
                else
                        $t=substr($blob,0,$x);
```

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```
                # save the time, the connection hash, the client,
                # the server, and the command to a list
                record system.time, tcp.connHash, tcp.connSrc, tcp.connDst,
                        $t to watchservers_list;

                # keep the remainder of the blob for the next pass
                $blob = substr($blob, $x + 1);
                }

        # keep us from getting flooded if there is no newline in the data
        if (strlen($blob) > 4096)
                $blob = "";

        # save the blob for next pass
}

watchservers_list = recorder ("bin/list packages/web/watchservers.cfg",
        "watchservers_schema" );
```

NFR is free for noncommercial and research use. It can be installed[5] on an Intel-based server running Linux or BSD, or a Sun server running Solaris. In addition, NFR, Inc. promises to keep the source code freely available. It is a great addition to the security administrator's toolkit.

In their efforts to create tools to do post-mortem analysis of hacker attacks, the authors of NFR have also created better tools for network monitoring that have some intelligence about the protocols they monitor, are more programmable, and have nice visual interfaces to help show you data that's important to you. The marriage of this emerging technology to the Web can lead to new tools to qualify and quantify Web behavior.

The Web Connection

I. **HTTP log integrity:** If you want to make sure that the logging mechanisms for your particular httpd are correct, or that you're seeing particular behavior, or if you're an ISP that bills by number of hits, it'd be convenient to have additional logging mechanisms to insure the integrity of your data.

Figure 5: Typical HTTP access_log

```
Dialup153.tcs.tulane.edu - - [22/Mar/1998:20:44:26 -0500] "GET /stilyagi/book.html HTTP/1.0" 200 4565
crawl4.atext.com - - [22/Mar/1998:21:02:12 -0500] "GET /~chad/gene/D0003/156.html HTTP/1.0" 200 868
grampa.gendex.com - - [22/Mar/1998:21:10:39 -0500] "GET /~chad/gene/GENDEX.txt HTTP/1.0" 304 -
tc3-35.dialup.coast.net - - [22/Mar/1998:21:23:16 -0500] "GET /~chad/wwwnfr.html HTTP/1.0" 200 12505
tc3-35.dialup.coast.net - - [22/Mar/1998:21:23:22 -0500] "GET /~chad/packet.gif HTTP/1.0" 200 1961
tc3-35.dialup.coast.net - - [22/Mar/1998:21:23:22 -0500] "GET /~chad/sniff.gif HTTP/1.0" 200 4688
ww-wc01.proxy.aol.com - - [22/Mar/1998:21:31:51 -0500] "GET /~sharon/resume.html HTTP/1.0" 200 3100
ww-wc01.proxy.aol.com - - [22/Mar/1998:21:31:53 -0500] "GET /~sharon/Same-komon.gif HTTP/1.0" 200 3608
199.221.88.74 - - [22/Mar/1998:22:11:51 -0500] "GET /cons/confusion.html HTTP/1.0" 200 3461
199.221.88.74 - - [22/Mar/1998:22:11:58 -0500] "GET /pic/alien.g.gif HTTP/1.0" 200 1200
199.221.88.74 - - [22/Mar/1998:22:11:58 -0500] "GET /cons/vintage.jpg HTTP/1.0" 220 6776
199.221.88.74 - - [22/Mar/1998:22:12:50 -0500] "GET /stilyagi/about.html HTTP/1.0" 200 16499
```

Typical log analysis tools like Analog [6] allow you to make the common log format into something easier to read, but can only track what an HTTP server can log.

Figure 6: Typical Web traffic analysis w/ analog

Web Server Statistics

Program started at Sun-15-Mar-1998 23:50 local time.
Analysed requests from Fri-11-Nov-1997 09:04 to Sun-15-Jan-1998 22:30 (65.6 days).

Total successful requests: 156 613 154 (9 660 543)

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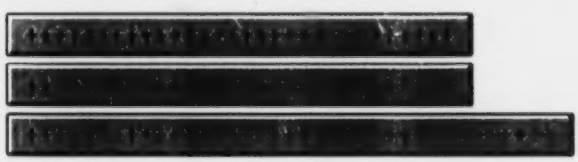
Average successful requests per day: 632 626 (1 380 077)
Total successful requests for pages: 9 680 303 (569 546)
Total failed requests: 315 167 (15 439)
Total redirected requests: 2 911 322 (280 036)
Number of distinct files requested: 62 272 (28 069)
Approximate number of distinct hosts served: 123 835 (57 321)
Approximate number of new hosts served in last 7 days: 2 017
Corrupt logfile lines: 6 852
Total data transferred: 276 381 Mbytes (13 871 Mbytes)
Average data transferred per day: 1 116 Mbytes (1 982 Mbytes)
(Figures in parentheses refer to the last 7 days).

Monthly report

```
   month:   #reqs:
--------   ------
Nov 1997: 119865:
Dec 1997: 121214:
Jan 1998: 224960:
```



Using tools like NFR, it is possible to do much more. For example, you can look at all traffic on your network on the basis of port number (for instance, port 80, the default for HTTP), list all web servers on your network (by scanning all TCP traffic for HTTP headers), and look at all HTTP requests going across your network on port 80. These functions can be combined to show all web traffic on any port. Any sniffer could give you this data, but NFR combines ease of use with a variety of output formats, including useful graphics such as bar charts, histograms, etc.

At this point, it may be worth mentioning that cookies are readily viewed by NFR or any other sniffer. Personal data is often stored in a cookie for the purpose of personalizing a page, listing a stock portfolio, or saving login and password information. Even if the cookie is encrypted, it may be vulnerable to electronic privacy invasion.[7] To check for a privacy invasion, you could log what goes into httpd as well as what comes out of httpd and compare.

Figure 8: NFR Query of Web client requests

Time	TCP Hash	Client	Server	Comma
Sat Jul 18 06:40:34 1998	244	141.217.139.132	204.71.177.172	GET / HTTP/1.
Sat Jul 18 06:40:34 1998	244	141.217.139.132	204.71.177.172	Connection: Ke
Sat Jul 18 06:40:34 1998	244	141.217.139.132	204.71.177.172	User-Agent: Mozilla/4.03 [e (Win95; I)
Sat Jul 18 06:40:34 1998	244	141.217.139.132	204.71.177.172	Pragma: no-cac
Sat Jul 18 06:40:34 1998	244	141.217.139.132	204.71.177.172	Host: my.yahoo
Sat Jul 18 06:40:34 1998	244	141.217.139.132	204.71.177.172	Accept: image/ image/x-xbitma image/jpeg,

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				image/pjpeg, */
Sat Jul 18 06:40:34 1998	244	141.217.139.132	204.71.177.172	Accept-Langua
Sat Jul 18 06:40:34 1998	244	141.217.139.132	204.71.177.172	Accept-Charset 8859-1,*,utf-8
Sat Jul 18 06:40:34 1998	244	141.217.139.132	204.71.177.172	Cookie: Y=v=1&n=45f c9n&l=3h_bkl_ 281f291131v; M=dp=sum&lg T=z=35af3d15
Sat Jul 18 06:40:34 1998	244	141.217.139.132	204.71.177.172	
Sat Jul 18 06:40:35 1998	287	141.217.139.132	204.71.200.245	GET /i/my/top7 HTTP/1.0
Sat Jul 18 06:40:35 1998	287	141.217.139.132	204.71.200.245	If-Modified-Sin Friday, 15-Apr- 00:00:00 GMT; length=1965
Sat Jul 18 06:40:35 1998	287	141.217.139.132	204.71.200.245	Referer: http://my.yahoo
Sat Jul 18 06:40:35 1998	287	141.217.139.132	204.71.200.245	Connection: Ke

Figure 9: NFR Query of TCP packets, source port 80

Source Port	Source Host	Destination Host	Bytes	Packets
80	24.1.109.239	141.217.139.109	384164	322
80	24.4.86.182	141.217.139.109	60685	45
80	24.92.105.152	141.217.139.65	464703	413
80	38.15.19.75	141.217.139.109	351	4
80	38.15.19.75	141.217.139.165	12258	14
80	38.15.20.75	141.217.139.109	16697	24

II. **Logging ephemeral data that might not otherwise be logged:** Most Web traffic is so short that it fits in the TCP/IP socket buffer. This makes it very difficult to determine if even the small answers to Web server requests actually made it to the other end. You could make the TCP/IP send buffer smaller, but then your Web server has to do more work. Answer: use an NFR to see what kind of bandwidth your WWW server really takes.

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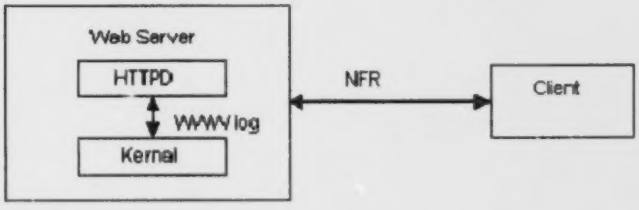
Fig. 10 Where NFR Tracks Data



Whereas the WWW log tracks information between httpd and the kernel, NFR tracks information between the Web server and the client.

With NFR, you can visualize data that isn't going to be obvious with some of the WWW logs. You can see how much of that 1.5GB JPEG the user with the 14.4k modem really downloaded before getting impatient and canceling the download. You can see 'dropped' connections. You can look for retransmits. In general, you can see what kind of bandwidth your WWW server is really using, data which won't be obvious by just counting transactions within the httpd logs.

III. **Finding Web servers on your local network on ports other than 80:** Many people run Web servers on ports other than port 80 for a variety of reasons. They don't have root on their Unix box and can't run on ports greater than 1024, they want to hide a massive archive of pictures[8] or an old, insecure web server running CGIs. You might be interested in recording who's running a Web server on your network, but may not want to set off alarms and waste cycles by beating every TCP/IP port on every machine with SATAN [9], and hoping that the banner the Web server uses identifies itself as a Web server. How can you tell if a given service is actually a WWW server? Use a NFR which looks for real HTTP traffic.

Figure 11: NFR track of HTTP traffic from a list recorder

```
Hash    Client          Server          Command
 18 208.218.124.77   208.218.124.42   GET / HTTP/1.0
 18 208.218.124.77   208.218.124.42   If-Modified-Since: Wednesday, 06-Nov-96 12:32
GMT; length=530
 18 208.218.124.77   208.218.124.42   Connection: Keep-Alive
 18 208.218.124.77   208.218.124.42   User-Agent: Mozilla/3.0Gold (X11; I; BSD/OS 3
i386)
 18 208.218.124.77   208.218.124.42   Host: cornfed
 18 208.218.124.77   208.218.124.42   Accept: image/gif, image/x-xbitmap, image/jpe
image/pjpeg, */*
 18 208.218.124.77   208.218.124.42
 18 208.218.124.77   208.218.124.42   GET /apache_pb.gif HTTP/1.0
 18 208.218.124.77   208.218.124.42   If-Modified-Since: Wednesday, 03-Jul-96 06:18
GMT; length=2326
 18 208.218.124.77   208.218.124.42   Referer: http://cornfed/
 18 208.218.124.77   208.218.124.42   Connection: Keep-Alive
 18 208.218.124.77   208.218.124.42   User-Agent: Mozilla/3.0Gold (X11; I; BSD/OS 3
i386)
 18 208.218.124.77   208.218.124.42   Host: cornfed
 18 208.218.124.77   208.218.124.42   Accept: image/gif, image/x-xbitmap, image/jpe
image/pjpeg
 18 208.218.124.77   208.218.124.42
```

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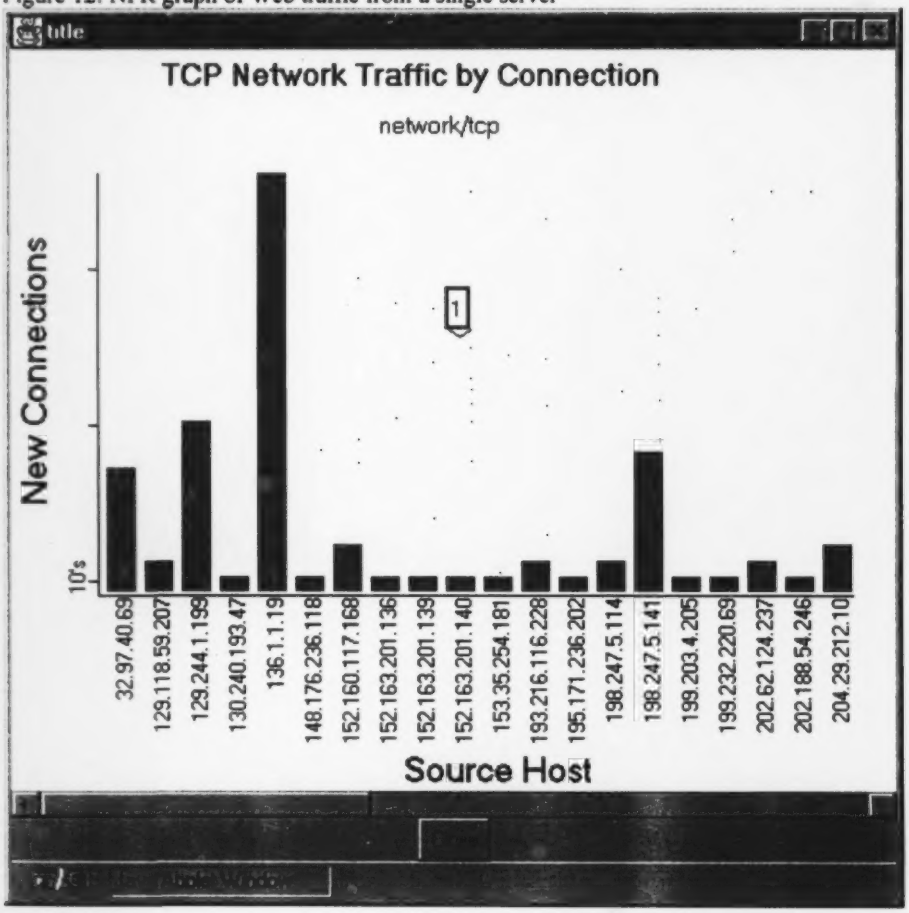
You may simply want to log a list of version strings of Web servers used on your network to inform the machine owners of when new httpds come out to fix holes (www.trouble.org).

IV. **Finding out what your Web client sends:** Some people are still surprised that the Web browser emits things like what kind of browser you use, HTTP_REFERER by default. You may want to know if your so-called "encrypted session" really is sending out credit card numbers -- for that matter, you may want to know if you have users who are inadvertently emitting credit card info using an unsecured WWW channel. NFR and similar programs can help you find out that information.

V. **Doing the analysis on a separate box:** HTTP logs can become unmanageably huge very quickly; a common problem in log analysis is simply getting the logs off of the server onto another box which has to spend more time running the analysis than it takes to build up another huge set of logs. Because NFR is not running on your Web server, this problem is easier to manage. It is extremely easy to tell NFR to track all HTTP accesses (that is, accesses on port 80) for a particular machine, or an entire network, and graph it as you like.

Figure 12: NFR graph of Web traffic from a single server



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VI. **Tracking problems with your Web server:** When users are constantly canceling a page during loading, because they are frustrated with the wait, the Web server administrator should take some action - but it is relatively difficult to determine when that is happening, and really unusual to do that kind of tracking with current tools. This leads to some really interesting ideas... the author of NFR read an earlier version of this paper and suggested tracking packet timing issues and actually using NFR to find out what bandwidth your users have, and the latency of the connection. Determining user bandwidth is something of a "holy grail" in Web circles, because with that information (which is often impossible to determine without asking the user directly) you can decide what size graphics are appropriate, and whether to use graphics and Java at all! When a robot is out there causing problems by inefficient or inappropriate searches, or something has hung on your network, you would want to know this, and NFR can be a tool to make you aware before the user complaints start coming in.

VII. **Network attacks:** Of course, it doesn't hurt to use NFR technologies for their intended purpose. There may be malicious folks trying all sorts of network-level attacks on your WWW server, or people trying to send bogus information to CGI scripts, just waiting to exploit some bug or another than compromises your system.

Conclusions

In actuality, the best part about the technologies that are emerging is that they're flexible and extendable, and have good visual tools so you can take that sniffer data and put it in a WWW page fairly easily. The whole purpose behind this paper isn't so much about specific applications for modern sniffers as much as raising awareness of their existence, that they are free to the academic community, and have the potential to be a great research tool.

---

[1] Network Flight Recorder, Inc. at http://www.nfr.com/

[2] Comer, Douglas E. *The Internet Book : Everything You Need to Know About Computer Networking and How the Internet Works*. Prentice Hall, August 1, 1997

[3] Network General at http://www.nai.com/

[4] Ranum et.al., "Implementing A Generalized Tool For Network Monitoring", Proceedings of the 11th Systems Administration Conference (LISA '97), San Diego, California October 26-31, 1997

[5] The installation of NFR is not difficult, if the system administrator performing the install has a good understanding of IP, MAC addresses, and web server configuration on your system. See the NFR Mailing List Archives for help with the install, at http://www.nfr.net/nfr/mail-archive/. Using NFR does not require a technical background, once it is installed.

[6] Analog: a WWW server logfile analysis program at http://www.statslab.cam.ac.uk/~sret1/analog/

[7] Childers, Bangert, et.al., "Open Standard Content Cookies", Proceedings of the WebNet 97 Conference, Toronto, Ontario.

[8] There are many such archives on the Net, from http://abc.com:1234/ to http://xyz.edu:6789/. If you find one which is particularly interesting, please email the authors.

[9] Security Administrator's Tool for Analyzing Networks at http://www.trouble.org/

QUEST: An Assessment Tool for Web-Based Learning

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Abstract: The Internet has great potential for educational purposes. In 1997, the Software Engineering Laboratory at PUC-Rio implemented a first version of AulaNet™, a web-based educational environment. This year, some of the teaching staff will be using this environment to offer regular term disciplines through the Web. This paper introduces Quest, a tool for quiz generation and automatic correction incorporated into AulaNet™. Its purpose is to support the educational assessment process through the Web and to grab the results of this process.

Introduction

With the fast emerging of the Internet, the Web has become an increasingly interactive and dynamic medium for sharing information. The Web provides an opportunity to develop new learning experiences for the students not possible previously [Alexander, 1995]. It has been increasingly popular to move away from the traditional model of education and move towards a more interactive, computerized system [Carbone and Schendzielorz, 1997].

AulaNet™ is a project in development at the Software Engineering Laboratory (LES) to deploy an environment for the creation and maintenance of Web-based courses designed for the layman. The objectives of AulaNet™ are to adopt the Web as an educational environment; to foster a workable transition from conventional classrooms to virtual classrooms, giving the opportunity to reuse the existing educational material; and to create knowledge communities [Lucena et. al., 1997].

Quest is a quiz generator and assessment tool incorporated into the core package of facilities provided by AulaNet™. It would be desirable for an interactive Web-based learning environment to have a Web-based way of assessing the students, instead of using a paper-based assessment.

Assessment

Assessment is defined as a direct measure of what has been learned as a result of instruction on particular subjects [Gagne et. al., 1988]. Assessment for distance learning has not yet been thoroughly researched [Dirks, 1997]. Some of the principles of the common paper-based assessment made in the conventional classrooms do not apply in distance assessment, such as reporting feedback and security.

However, the Internet shall be used to create environments that facilitate an active and customized process of learning, supporting cooperation. In such a cooperative environment, assessment may not only involve measuring the students' ability to remember and repeat ideas, but should also make people think about problem situations and new solutions to them [Cox and Clark, 1996]. The strategy of Quest is to provide a simple multiple choice-like assessment tool that can be used not only to test the students but also to enhance the learning process.

In structuring a quiz it is important to work with a theoretical framework of learning. There are several learning objective taxonomies as can be seen in [Imrie, 1995], [Gagne, 1982]. Bloom's Taxonomy of Cognitive

Levels [Bloom, 1956] divides students' abilities into six different levels, which are: knowledge, comprehension, application, analysis, synthesis and evaluation. Using Bloom's taxonomy, a teacher can make a deeper evaluation on the students' performance, instead of only checking their grades.

Description of Quest

The main goal of Quest is to serve as the Web-based assessment tool of the AulaNet™ learning environment. Its other goals include:

1. *Lowering quiz costs*: the process of creating, correcting and reporting student results in a paper-based system, of a large number of students, is very time consuming [Tinoco et. al., 1996]. This whole process requires time, money and staff that must be handled and administrated.
2. *Making extensive reporting*: Quest records all the information about the answers given by the students to make a comprehensive report of results for the teacher.
3. *Giving feedback to students*: instead of recording the results just for the teacher, Quest gives automatic feedback to the students, so they can have all the information about their performance on the fly, instead of asking the teacher.
4. *Enhancing the cognitive aspects of assessment*: while editing a question, the teacher tells which cognitive domain (from the six outlined by Bloom) he wants to assess. Thus, writing an evaluation must be planned, enriching its educational value.

There are other assessment tools available, such as QUIZIT [Tinoco et. al., 1996], CADAL Quiz [Carbone and Schendzielorz, 1997] and QuizSite [University of Indiana, 1996]. However, they do not provide a graphical interface for question editing. These systems require that the teacher learn some tag language to create a quiz. Quest provides a graphical interface to make editing questions easier, without demanding any kind of computer knowledge being necessary. Other features of the tool include:

a. Three question presentation styles: Quest is a multiple choice-like assessment tool, but provides three question presentation styles for question editing: multiple choice (with up to five answer choices), true/false and fill in. Later, it may offer matching and listing.

b. Editing Facilities: the tool offers quiz editing facilities such as moving the position of the questions, removing questions and insert questions between existing ones. This is done automatically due to the graphical interface (non-textual) provided by Quest. Quest provides an easy way to reedit created quizzes, with a "save as" option, for the teacher not to loose the original one.

c. Question qualifiers: while editing a question, the teacher should give it some qualifiers, for example, the topic of the instructional material it will cover, the cognitive domain level it will test and its value. These qualifiers will be useful when displaying the statistics generated by the automatic correction of the quiz, giving richness to these statistics.

d. Automatic correction: the process of quiz correction is done automatically by the tool. The teacher only needs to specify the correct answers at the time of editing; thus, giving him more time to interact with the students. The correction mechanism stores all the data needed to make the statistical results provided to the teacher and the performance information handled just in time to the students.

e. Results displayed to students: since Quest is a self-assessment tool, it is fair the students need not be dependent on the teacher to send them an e-mail to know about their performance. Carbone and Schendzielorz [1997] argue that this would increase cheating. Yet, as self-evaluation serves to indicate to students, and not to the teacher, if they are doing well in the learning process, it is important to the students to have a feedback. Thus, when a student cheats, he is aware that he is just trapping himself.

f. Storage of results for the student: usually, the results of an assessment are stored for the teacher, so he can have a way of bringing back at any moment the information about any quiz on the course. Quest also stores the information to be displayed at any time to the students. This information includes: grade; total quiz points;

number of questions in the quiz; number of questions the students answered correctly; number of questions answered incorrectly; time elapsed during the quiz resolution; the topics enclosed in the questions of the quiz; the topics of the questions the students answered incorrectly and an option for the students to revise the quiz, comparing the right answers with those they gave. This last feature was included in the tool to provide a source of help material for further studying, as these results are formatted to show the problems the learners faced.

g. *Detailed statistics for the teacher:* the teacher can have plenty of information derived from the correction of a quiz. The main idea behind the statistics provided to the teacher is that he must have a way of seeing the students' learning development, to trace where they are facing difficulties and to compare the performances of the group as a whole, not, one by one, individually. These statistics include:

- List of grades: this list serves to see the grades of each student with an option to revise the answers given by all the students. This is the way it is done in the conventional classroom.
- Statistics based on topics: a result displayed as a list of topics gives the teacher a way to know the points of the instructional material the students are having problems with. The topics are atomic instances of the course, and interpreting these statistics can be useful to see if the material delivered by the course fits the needs and objectives of the students and those of the course itself.
- Statistics based on cognitive domain: these statistics show if the students are constructing their knowledge correctly. It exposes the cognitive abilities in which the students show more difficulty. After this verification, the teacher can reshape the contents of the course to solve these problems, really helping the students to: remember an idea; understand it; put it into practice; verify its component parts; use it to build another idea and evaluate its usage.
- Statistics per question: statistics showing the troubles the students had in solving each of the questions in the quiz. This can be used to see the average difficulty of the questions, and like a cross-reference of the two previous statistics it will show whether the students had problems in understanding a topic, or applying it or evaluating the usage of another one, for example.
- Standard scores: standard scores involve calculating average scores and information about how much these vary from high to low—the standard deviation. Average scores should be concluded with their standard deviation, and listing of the highest and lowest scores possible as well as the highest and the lowest scores actually received. It would end with a sentence like this: "There were 35 students who took the quiz. The possible scores ranged from 0 to 100, with the students actually scoring from 32 to 95 (average score: 72, standard deviation: 6.1)."

Architecture and Implementation Issues

The architecture of Quest is based on the Web, where its entire interface is developed, using CGI programs to provide all its functionality. The figure below shows the tool's architecture.

The architecture has a presentation layer, which is the user interface. It is basically composed of HTML templates that help the teacher to create, edit and maintain all the quizzes. There are also some tips to help the teacher during the process. For example, if a teacher wants to create an analysis question, the tool offers him a list of verbs that are commonly used to write analysis questions. Another task of the presentation layer is to make input validation, i.e., verify if the teacher did not leave a field in blank, if he miswrote a date, etc. This feature makes Quest a distributed tool, with part of the processing resident in the client machine, due to JavaScript code.

The application layer is responsible for all the functionality provided by the tool. It is composed of CGI programs written in CGILua [Hester et al., 1997]. It uses Lua objects [Ierusalimschy et al., 1996] to perform the handling of questions, the generation and display of quizzes, automatic correction and the feedback statistics of the results for both students and teachers.

The Lua objects layer offers all the functionality needed to allow for the exchange of data between the CGI programs within the application layer and the data layer. It accesses the tool's database engine and also allows for the writing and maintenance of the HTML quiz files.

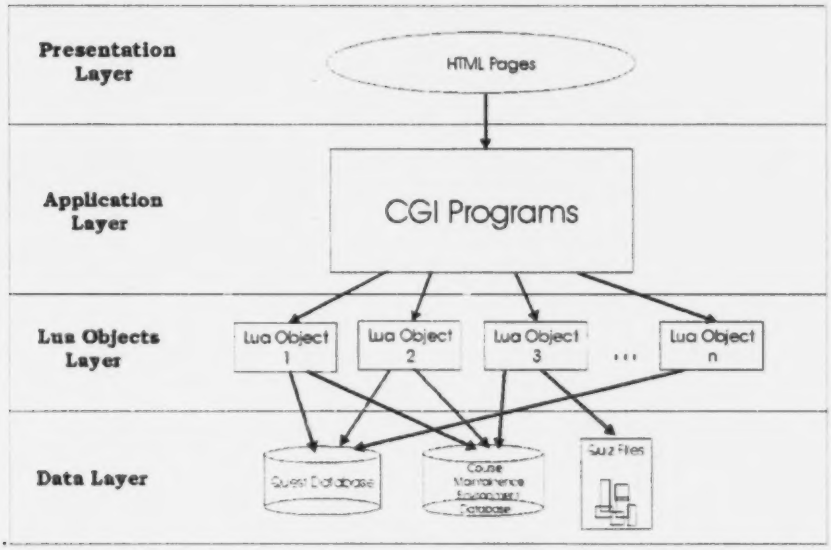

Figure 1: Quest Architecture

The data layer is composed of two databases and a file directory. The first database is a Microsoft Access database used to store the data related to questions and quizzes. The Lua objects of Quest only access this database. The second database refers to the data of the course maintenance environment, which describes the courses and the students who will use the tool. The file directory contains all the HTML files of the quizzes generated.

Example of Usage

The AulaNet™ environment has two distinct modules: the course creation and maintenance module, for the teachers and the course attendance module for the students. In the course creation and maintenance module, the teacher can configure his course to have the service Exam. Since a teacher configured his course to have this service, he will be able to create quizzes using Quest.

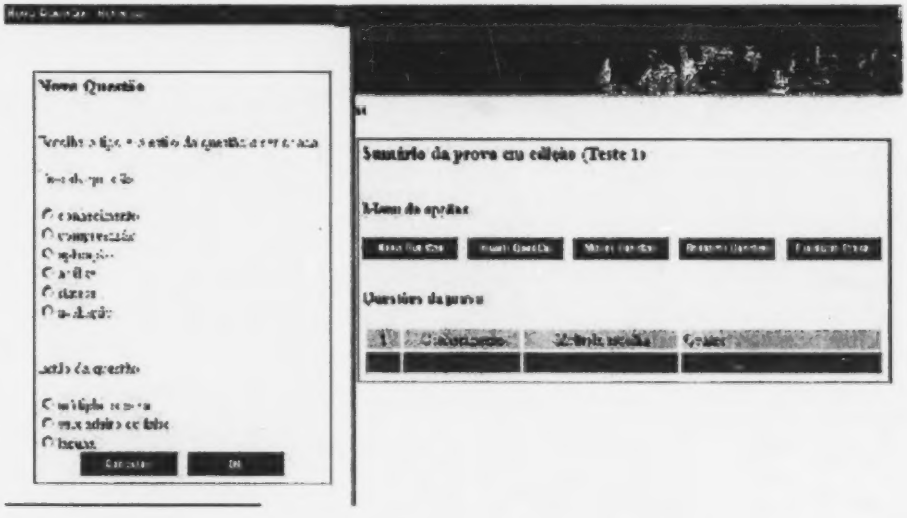

Figure 2: Quiz edition windows

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The main screen of Quest is divided in two parts: the options menu and the main area [Figure 2]. In the options menu, is listed the edition facilities provided to the teacher. The main area displays the tracking of the quiz under edition. The edition of a question is done in a float window [Figure 2]. When the teacher is done editing he finishes the quiz and the tool generates its HTML file.

Then, a student, in the attendance module, takes the quiz and submits it to automatic correction [Figure 3]. Right after correction, he receives feedback showing his performance. The teacher, in his module, gets detailed statistics collected in the results of the assessment process.

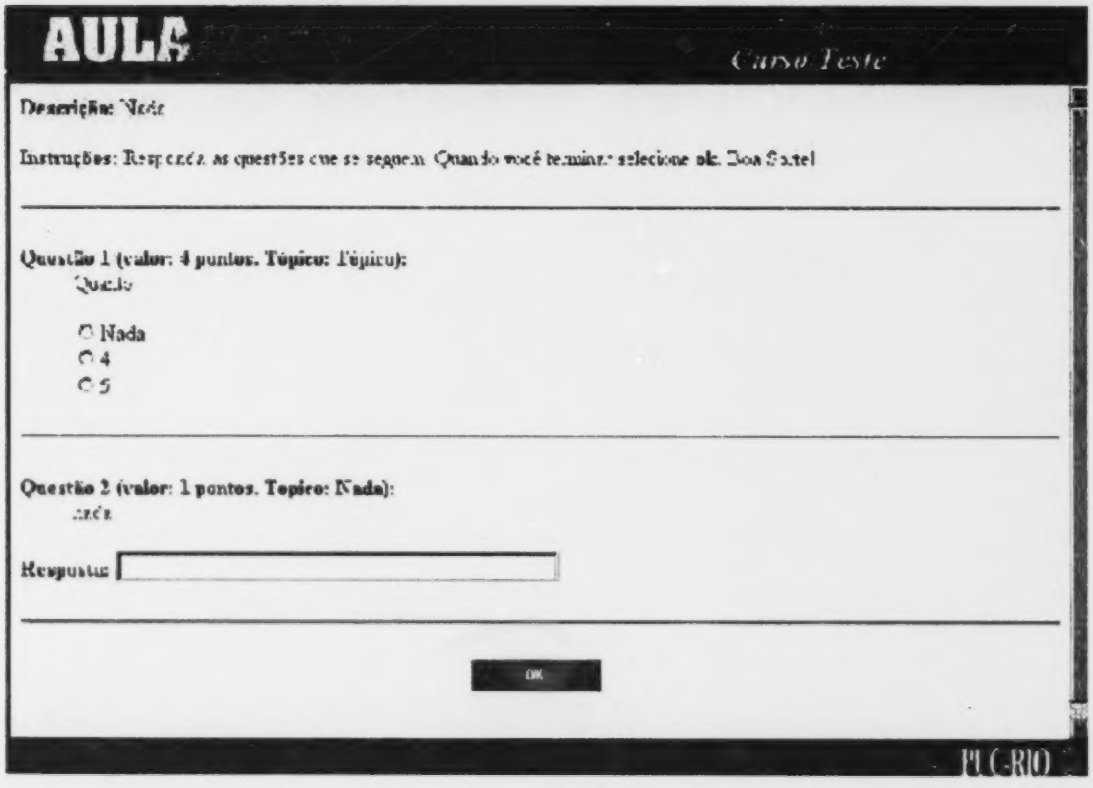

Figure 3: Student quiz taking window

Conclusions

The Internet has great educational potential [Eales and Byrd, 1997] and Quest is a tool for generating quizzes and assessing materials on the Web. The process of creating and editing questions is made on a graphical Web interface, thus making the tool completely Web designed. It also aims to help teachers assess all the cognitive abilities of the students, not only their ability to memorize information. This tool delivers statistics both to the students and the teachers so that they can see if the material offered on the course meets all their purposes and needs.

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An Integrated System for Multilevel Secure Compound Documents

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Abstract: For computerized information, multilevel security of digital documents is necessary for many applications. However, traditional multilevel key encryption systems do not consider the key-expiration and time-bound problems. Therefore, we propose and implement a scheme that allows users to edit and browse compound documents of multimedia data. Each component in a compound document is assigned a security class separately. Only legitimate users with equal or higher clearances can browse the document component. Our scheme includes a time-bound feature, which is suitable for many applications.

I. Introduction

In a computerized society, people use computers not only to compute, but also to record and communicate information in many forms, such as texts, images, voices, animation, etc. Because of versatility of the World-Wide Web, we can design many applications on it, for example, electronic newspapers, digital libraries, electronic commerce, etc.. However, there are occasions that we need retain secrecy for digital data. For example, parents want to keep children away from violent and pornographic publications. Furthermore, there are occasions, for example, that a company may allow an employee at a certain clearance to read secret documents at certain security class only. Therefore, we need multilevel security in controlling access to digital data. We illustrate this by a paid electronic newspaper subscription system as follows. A newspaper publishing company provides electronic newspapers to subscribers. The company allows a subscriber to subscribe his interested categories, such as sports, business, etc. To save the bandwidth, the company broadcasts everyday newspaper to its subscribers. However, the company would like a subscriber who subscribes the category of sports can read the sports category only, while a subscriber who subscribe the whole newspaper can read all. Furthermore, the company would like the subscribers to read the newspapers that are within their subscription period only.

In this paper we provide a solution for the above, that is, we design and implement a time-bound multilevel security system that allows users to edit and browse compound documents of multimedia data. In our system, each component of a compound document is classified into a security class by its sensitivity. Each security class C at time T has a secret (cryptographic) key $K_{C,T}$ and a component in a security class is encrypted with key $K_{C,T}$, where T is the time that the component is added. To access components in a compound document, a user need to have the corresponding keys. However, we don't want a user to have a lot of keys since it is hard to manage them. We design a cryptographic scheme such that each user has only one secret information. In particular, if a user is at security class C between time t_1 and t_2, he is given a secret information $I(C, t_1, t_2)$ so that the secret information can be used to derive secret key $K_{C',t}$ if C' is lower than or equal to C and t is in between t_1 and t_2.

We now see how the subscription system works. When a subscriber pays for the category C from time t_1 to t_2, he is given the information $I(C, t_1, t_2)$. In some day t, he receives an electronic newspaper N from the publisher. If t is in between t_1 and t_2, the subscriber decomposes N to get the components M of class C', C' symbol 163 \f "Symbol" \s 10≤} C. The subscriber then use $I(C, t_1, t_2)$ to derive the key $K_{C',t}$ to decrypt M and reads it. Since $I(C, t_1, t_2)$ can only derive keys $K_{C',t}$, where C' is lower than or equal to C and t is in between t_1 and t_2, the subscriber can only read the subscribed categories within his subscription period.

The distinct features of our system are: (1) It can edit and browse compound documents with time-bound multilevel security. (2) Compound documents are accessible through networks, but only a user with a legal key can read the component that he is authorized to. (3) Each component is encrypted and stored

once and suitable for different security classes and time. (4) Each user has only one secret information, which is independent of the number of security classes.

A. MIME Mechanism

We use the MIME (Multipurpose Internet Mail Extensions) [Borenstein and Freed 93, Moore 93] mechanism to include various kinds of multimedia data into a compound document. MIME allows multi-part textual and non-textual message bodies to be represented and exchanged without loss of information. It provides facilities to include multiple objects in a single message, to represent body text in character sets other than US-ASCII, to represent formatted multi-font text messages, to present non-textual materials, such as images and audio fragments, and to facilitate later extensions for defining new media types for cooperating mail agents.

We extend the MIME mechanism for our security scheme. This extension is capable of handling our time-bound multilevel data security requirements as well as compatible to the existing MIME mechanism. We define new types for encrypted parts. Each part is associated with a module name, a security class, and a publishing time. Only the legitimate users who are with the same or higher clearance and with the correspondent secret information (about the security class and publishing time) can open up the encrypted parts and read the information on our browser.

For the editor module, users can edit textual and non-textual data, assign each part a corresponding security class and publishing time, and put them together as a compound document. After all are done, our editor module composes and encrypts them accordingly.

As for the browser, we use a parser to preprocess MIME-compliant documents. The browser provides a user-friendly interface that helps the user to browse the authorized components that the user is entitled to. Besides, we embed the transmission ability into our browser so that the browser is able to access or download from the document databases distributed over the networks. We use HTTP (Hypertext Transfer Protocol) protocol for the transmission protocol, which is commonly used to retrieve files in the World-Wide Web. A user simply types the desired URL (Uniform Resource Locators) address in a dialog box; the browser does the rest.

I. Time-Bound Multilevel Data Security

The multilevel data security problem in the form of cryptographic key assignment was first studied by Akl and Taylor [Akl and Taylor 83]. The multilevel data security problem takes place in many occasions. For example, in the military organization, data are typically classified as *top-secret* (TS), *secret* (S), *confidential* (C), and *unclassified* (U), where TS is the highest security class and U is the lowest security class. Officials in the security class TS can read all documents, while officials in the security class S can read documents in the security levels S, C and U, but not those in TS.

Formally, a multilevel security system can be expressed as a partially ordered hierarchy where users and data are grouped into a number, say m, of *security classes* C_i, 1 symbol 163 \f "Symbol" \s 10≤} i symbol 163 \f "Symbol" \s 10≤} m. These security classes (or *classes* for short) are partially ordered such that data in class C_i can be accessed by users in class C_j if and only if C_i symbol 163 \f "Symbol" \s 10≤} C_j. We augment multilevel security to time-bound multilevel security with motivation as described in [Introduction]. We need the Lucas function first. Let $V_0(x) = 2$ and $V_1(x) = x$. Then for n symbol 179 \f "Symbol" \s 10≥} 2

$$V_n(x) = xsymbol\ 215\ \f\ "Symbol"\ \s\ 10\cdot\}V_{n-1}(x)-V_{n-2}(x).$$

For given n and x, it is computationally feasible to compute $V_n(x)$.

Our time-bound multilevel security (time-bound cryptographic assignment) [Tzeng 98] is as follows, where z is the maximum time.

1. It has a key center (KC) for time-bound key generation.
2. KC randomly chooses four primes p_1, p_2, q_1, and q_2 and lets $n_1 = p_1q_1$ and $n_2 = p_2q_2$.
3. KC chooses two random numbers *symbol 97 \f "Symbol" \s 10*α and *symbol 98 \f "Symbol" \s 10*β, where 1 < *symbol 97 \f "Symbol" \s 10*α < n_1 and 1 < *symbol 98 \f "Symbol" \s 10*β < n_2.
4. KC assigns each class C_i, 1 symbol 163 \f "Symbol" \s 10≤} i symbol 163 \f "Symbol" \s 10≤} m,

a number e_i relatively prime to *symbol 102 \f "Symbol" \s 10*$\phi(n_1)$ and computes d_i such that $e_i d_i \bmod$ *symbol 102 \f "Symbol" \s 10*$\phi(n_1) = 1$.

5. KC computes K_i, 1 symbol 163 \f "Symbol" \s 10≤} i symbol 163 \f "Symbol" \s 10≤} m, as
$$K_i = \alpha^{\prod_{C_j \in C_i} d_j} \bmod n_1 .$$
6. For the time period t, 0 symbol 163 \f "Symbol" \s 10≤} t symbol 163 \f "Symbol" \s 10≤} z, the KC chooses two numbers f_1 and f_2 and computes
$$w_t = V_{f_1^{z-t} f_2^t}(\beta) \bmod n_2 .$$
7. KC chooses two numbers g_1 and g_2 relatively prime to *symbol 102 \f "Symbol" \s 10*$\phi(n_1)$ and computes h_1 and h_2 such that $h_1 g_1 \bmod$ *symbol 102 \f "Symbol" \s 10*$\phi(n_1) = 1$ and $h_2 g_2 \bmod$ *symbol 102 \f "Symbol" \s 10*$\phi(n_1) = 1$. The key for class C_i at time t is
$$K_{i,t} = H(K^{h_1^t h_2^{z-t}}, w_t),$$
where H is a one-way hash function.
8. The public parameters are: n_1, n_2, e_i, 1 symbol 163 \f "Symbol" \s 10≤} i symbol 163 \f "Symbol" \s 10≤} m, g_1 and g_2.

For a user with security class C_i between t_1 and t_2, he is given the secret information $I(C_i, t_1, t_2) = (x, y)$, where

$$x = K_i^{h_1^{t_2} h_2^{z-t_1}} \bmod n_1 \text{ and } y = V_{f_1^{z-t_1} f_2^{t_1}}(\beta) \bmod n_2 .$$

To derive a key $K_{j,t}$ for class C_j at time t with C_j symbol 163 \f "Symbol" \s 10≤} C_i and t_1 symbol 163 \f "Symbol" \s 10≤} t symbol 163 \f "Symbol" \s 10≤} t_2, the user uses his secret information I and public parameters as follows. He first computes

$$\begin{aligned}
& x^{g_1^{t_2-t} g_2^{t-t_1} \prod_{C_k \in C_i, C_k \in C_j} e_k} \bmod n_1 \\
&= \alpha^{g_1^{t_2-t} h_1^{t_2} g_2^{t-t_1} h_2^{z-t_1} \prod_{C_i \in C_i} d_i \prod_{C_k \in C_i, C_k \in C_j} e_k} \bmod n_1 \\
&= \alpha^{g_1^{t_2-t} g_2^t h_2^z \prod_{C_i \in C_i} d_i \prod_{C_k \in C_i, C_k \in C_j} e_k d_k} \bmod n_1 \\
&= \alpha^{h_1^t h_2^{z-t} \prod_{C_i \in C_j} d_i} \bmod n_1 \\
&= K_j^{h_1^t h_2^{z-t}} \bmod n_1 ,
\end{aligned}$$

and

$$\begin{aligned}
& V_{f_1^{t_2-t} f_2^{t-t_1}}(y) \bmod n_2 \\
&= V_{f_1^{t_2-t} f_2^{t-t_1}}(V_{f_1^{t-t_1} f_2^{t_1}}(\beta)) \bmod n_2 \\
&= V_{f_1^{t_2-t} f_2^{t-t_1} f_1^{t-t_1} f_2^{t_1}}(\beta) \bmod n_2 \\
&= V_{f_1^{z-t} f_2^t}(\beta) \bmod n_2 \\
&= w_t .
\end{aligned}$$

Then, he computes $K_{j,t} = H(K_j^{h_1^t h_2^{z-t}} \bmod n_1, w_t)$.

If a user knows the secret information K_i and w_t, he can compute $K_{j,t}$ efficiently. However, for an attacker who does not know the secret information, it is difficult to compute $K_{j,t}$ because of the following two reasons: (1) Computing K_i is equivalent to breaking the RSA cryptosystem [Rivest 78]. (2) The security of w_t is guaranteed by the Lucas function since the Lucas-function-based cryptosystem is generally considered as secure as the RSA cryptosystem. Furthermore, even if the attacker knows $K_{i,t}$, he can not compute K_i and w_t because one-way function H is applied on them.

I. The Integrated System

A. Document Format

We follow the MIME mechanism to encapsulate the different parts into a single document. In the MIME format, multiparts of different data are embedded into one single message by specifying their characteristics in the header that precedes each part of the message.

To meet the security requirements, we make extensions to the original definitions in the standard by creating new content types. That is, we append a "*-encrypt*" postfix to each content type. For example, we add *image/gif-encrypt* for *image/gif* and *text/plain-encrypt* for *text/plain*. So, a body part in a MIME message with the following header

```
Content-Type: image/jpeg; name="uno.jpg"
Content-Transfer-Encoding: base64
```

has a corresponding header that specifies an encrypted data in our system as:

```
Content-Type: image/jpeg-encrypt; name="uno.jpg"
Content-Transfer-Encoding: base64
```

Therefore, when the extended MIME parser identifies an encrypted message, it invokes the base64 decoding function to produce the ciphertext for later use.

To support time-bound multilevel data security, three additional lines are appended at the beginning of the decoded data. The first line tells the name of the security module, for which the encrypted data is intended. A security module can be a company, a publication, a government department, etc.. Each security module is further classified into several security classes or security levels, and the intended security class of the data is specified in the second line. The third line specifies the publishing time of the data. For example, the following three lines tell that the data published in October 1997 is intended for the organization *NCTU* and its security class is 5.

```
Security-Module: NCTU
Security-Class: 5
Publishing-Time: 9710
```

Only a user in this organization who has an equal or higher clearance with time period containing the publishing time can open this part with the corresponding key derived from his secret information.

A. System Components

Our system includes three major modules: an extended MIME parser/composer, a MIME browser/editor window to edit and display the documents, and an HTML browser.

1. The Parser/Composer Module

The secure compound document preprocessor, or the extended MIME parser, syntactically analyzes a compound document according to the headers preceding each part of data. The data may be a plaintext, which can be directly displayed in the text viewer, or a piece of information encoded with several different algorithms, like the *base64* or *quoted-printable*. Therefore, the parser should invoke the corresponding decoding function to generate the right information. Furthermore, if the parser identifies an encrypted data, it needs to first decode the data with the base64 decoder, extracts the security information, and then decrypt the ciphertext. Of course, if the user does not have the correct secret key, the preprocessor cannot decrypt the information and just ignores this part of data.

The composer, on the other hand, encapsulates the body parts by necessary encoding and attaching appropriate headers specifying the properties of the data. If the data is sensitive, the composer would first invoke the DES function to encrypt it with secret keys. The multilevel secret keys can be generated by the information-provider through the dialog box embedded in our editor and distributed to the intended users or information-subscribers.

1. The Browser/Editor Window

There are a narrow URL bar and two child windows in the browser/editor window. The URL bar is for the user to assign the location of a compound document. Documents are downloaded via HTTP from a remote document server, and then the control flow passes the raw data to the parser. The main textual data in the document is shown in the upper child window and the other accessible attached parts are shown as small icons in the bottom child window. The user can invoke corresponding viewers to browse the attached parts that he is entitled to, that is, he has the corresponding decryption keys.

We can also use the browser/editor window to edit the documents. Textual data are edited or modified in the upper child window, or the text window. Attachment is created by first selecting the content type of the component and specifying the filename through the window menu, which creates a new icon in the bottom child window, or the attachment window. Users can then double-clicks the icons to invoke the applications specified in a setup dialog for further editing or browsing the components. Removal of attachments is also done simply by deleting the icons in the attachment window. After all editing work is done, users can then click the components and assign their security module and class. When the file is to be saved, system will then pass the document information to the composer for final and necessary processing.

Other features, such as dialogs for bookmark management, viewer locations, security settings and key generations, can be invoked through the window menus.

1. The HTML Browser

Our system also supports HTML formats. It can browse HTML files. It can also invoke an independent WWW browser, such as, Internet Explorer of Microsoft and Communicator of Netscape.

I. Conclusion

We have designed an integrated system for editing and browsing compound documents with the feature of time-bound multilevel security. The compound document can handle many types of multimedia data and is compliant with the MIME mechanism. If unknown MIME formats are received, our system offers a convenient way to handle it. The system provides a useful prototype for an information provider or organization to control access of information if hierarchical access control is necessary. Our solution is based on a cryptographic method. It can protect information against network pirates with theoretical soundness. Therefore, the system can ensure security and profits of information owners if they need.

We can still improve our system. For example, when new keys are computed, we need to distribute them to legal subscribers in a secure way. Therefore, we may need to incorporate secure mail and secure authentication modules for key distribution.

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Three Course Exemplars of Situated Learning

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Abstract: In this presentation we describe and compare three online courses by looking at design features using general principles of situated learning and by assessing the "fit" between instructional design features, the general "type" of students registered in the courses, and differences in content between courses. Three conclusions are: 1. The more constructivist principles that are embedded in a design, the less re-designing is needed, 2. Implementing an appropriate design takes advantage of student diversity, and 3. Although content and students may differ, courses would benefit with the implementation of some principles of constructivism.

Introduction and Overview

Finding ways to enhance pedagogical aspects of teaching and learning in the computer-based medium is quickly becoming a new priority. The field of cognition and instruction offers a rich resource of empirically grounded theories and models of learning suitable for instructional design of online courses. We are currently exploring the potential for using constructivist theories in hypermedia learning environments, particularly "situated learning" theory with its emphasis on collaborative learning in "authentic" instructional settings. The fundamental assumption of this theory is that truly meaningful learning arises from students' active engagement in shared learning experiences that are anchored in tasks, activities, or settings that reflect realistic situations students are likely to encounter [Brown, Collins and Duguid 1989] [Lave 1988]. The close integration of theory and practice reflected in the situated model of learning neatly captures the dynamic nature of interactions between the cognitive and social dimensions of learning. The conferencing capabilities of interactive technologies are ideally suited to support the creation and management of shared learning opportunities for students studying online. In this presentation we describe and compare three online courses in two ways: First, by looking at design features using general principles of situated learning adapted from the work of [Salomon and Perkins 1995], and second, by assessing the "fit" between instructional design features, the general "type" of students registered in the courses, and differences in content between courses.

Principles of Instructional Design

Principle 1. Effective learning requires that learners engage actively in manipulating the target knowledge, thinking and acting on the basis of it to revise and expand it (p.116). *Principle 2.* The hallmark of understanding something is being able to think with what you know about the something; understanding is acquired through engagement in activities that call for such thinking(p.117). *Principle 3.* Understanding something involves building a rich and broad semantic network of relationships in which the target knowledge sits, with links supportive of kinds of thinking pertinent to the target knowledge(p.118). *Principle 4.* The learning of individuals

gains from patterns of social interaction that support the construction and distribution of knowledge and understanding(p.119). *Principle 5.* Effective learning needs to occur in social and activity settings that have authenticity as settings of learning and as gauged by later potential applications (p.121). *Principle 6.* Through processes of diverse practice or active abstraction, useful general knowledge can be drawn from and applied to particular contexts (p.121).

1. Designs for Learning: Writing

The overall online design of the course, *Designs for Learning: Writing* [Mamchur 1997] is organized around three basic tenets of the situated learning model. Much of what is learned is specific to the context in which it is learned; the construction of knowledge takes place in social settings; learning occurs through situated and authentic tasks [Good and Brophy 1995]. These tenets are reflected in the basic premise of the course, that is, in order to write creatively and to teach writing, one benefits most by learning to write well, for and with others. During the design phase the six principles of constructivism were incorporated by integrating, enhancing and expanding opportunities for students to acquire skills through collaborative writing, reciprocal teaching, and classroom practice activities. These are illustrated as follows both within and across course units and in the "authentic" contexts of students' actual classrooms.

Organization and Structure

The course is presented in two modes -- print, comprising course materials, and online via FirstClass Systems conferencing, where all instructor and peer teaching activities take place. Thus individual, small group, and applied tasks converge in the conferencing medium and the various conferences for each unit of the course are designed according to the activities specific to the unit. Because writing skills development builds incrementally over the duration of the course, conference design captures activities across units as well. There are four units covering four key writing themes. Each unit contains three instructional strands through which knowledge building activities take place: 1. *Writing*, where students are introduced to and practice the skills through discussion and modeling activities provided by the instructor, 2. *Collaborating*, where students work together providing peer feedback on writing samples, share information from course tasks, and edit one another's work, and 3. *Teaching Writing*, where classroom materials are designed and first tested through reciprocal teaching and then in the teacher's respective classrooms.

Implementing Constructivist Principles

All threads are set out according to the general organizational and interactive principles of constructivist learning presented above. Although each thread is reflected in all of the principles, some are more prominent than others in certain of them as the following description illustrates. What emerges is an instructional design matrix of threads within and across units.

Principle 1 primarily informs design of the "Collaborating" strand of activities. This is the section is where students are expected to do tasks singly, then in combination with a partner, small group, or whole group that are based on information and illustrations from strand one. Students engage in peer feedback and peer editing on a variety of tasks, revising their work, and enhancing or expanding both unit specific writing tasks and sections of more comprehensive work.

Principles 2 and 3 primarily informs design of the "Writing" strand of activities where students are introduced to important concepts, associated writing skills, and how to make informed choices about, and begin their own writing selections. Strand one provides the foundation knowledge upon which the course is constructed. *Principle 3* addresses the incremental nature of knowledge and skill building over the duration of the course.

Building broad and rich semantic networks of information occurs primarily through collaborative activities organized within and across the strand two which, in turn, is based on the information presented in strand one within and across units.

Principle 4 underscores the interactive nature of teaching and learning which permeates this course. The conferencing medium is ideally suited for this purpose as students, all working professionals, are free to participate as often as their time constraints allow. The foundations of knowledge building and the acquisition of skills take place throughout the course, but primarily within and across strands two and three. Social learning activities and the resultant distribution of knowledge and skills occurs between partners, in small, and in whole group conferencing sessions. Here, the instructor's role is initially prominent but then fades as students are encouraged to assume responsibility for their own and other's learning.

Principles 5 and 6 highlight the importance of the need for students to work in "authentic" learning situations. Throughout strand three students are designing activities that incrementally reflect the mastery of the skills, teaching strategies, and conceptual understanding gained in the other two strands. These activities are implemented in the students' own classrooms after a trial period in the conferencing groups. Feedback from the classroom setting is reported back to the conference participants and necessary changes and adjustments are then made.

Reflections on Design

Overall, this course was so successful that students continued to network long after the semester was completed. This phenomenon continues with each offering of it and students from earlier semesters will sometimes "drop in," with permission, to work with or assist those currently registered in the course.

2. Issues in the Information Society: Software Design

The *Issues in the Information Society* course addresses communication technologies from a variety of perspectives [Tiessen 1995]. This course provides a unique opportunity to apply a situated course design by involving students in the authentic task of using educational technologies in an educational setting to critically examine the influences of software design from an interdisciplinary perspective. Students assess the effectiveness of Virtual-U™ software as a communication medium for accomplishing their collaborative work, and as an educational medium for online course delivery. In addition to performance and technology issues in software design, class discussion pertaining to the social implications of online education are situated in the context of taking an online course. A further dimension is that the design of the students' interactions supports the same educational principles of active and collaborative learning, multiple perspectives, and knowledge building, which inform the design of Virtual-U™.

Organization and structure

The course combines face-to-face meetings and networking activities. Face-to-face meetings deal with organizational aspects of the course such as coordinating student project groups. The online component is fully into the course design. The course is organized into three phases. Phase I is a general orientation to issues of an information society and an introduction to Virtual-U™ software in the context of these issues. Phase II involves group investigation into the design of technology for the information society, and Phase III involves a team design project incorporating the interdisciplinary perspectives researched during Phase II. To illustrate how [Salomon and Perkins 1995] principles of situated learning are incorporated into the design of this course, each phase is described below.

Phase I (4 weeks) Here, several aspects of situated learning design are woven into. Orientation to issues of the information society is achieved by combining whole and small group discussions. Brief reports prepared by small group participants are shared with the whole class to compare understandings. This engages students in a process of thinking about elements of software design, then using that knowledge to come to a shared understanding of the broader context of social and psychological consequences of design (principle 2). In addition, a clear purpose for these activities is held in common throughout Phase 1. Students become aware of their background knowledge, learning needs, and interests, to better determine their fit into the design teams to be formed during Phase II (principle 5). Since participation in the design team environment requires a clear understanding of expectations within that context, Phase I sets the stage for later work in Phases II and III.

Phase II (5 weeks) During Phase II students organize into five design teams to develop expertise in each of the following design perspectives: Human-computer interactions design, educational software design, group communication and computer conferencing design, collaboration and groupware design, and hypermedia systems and tools design. Throughout Phase II students are encouraged to use conferencing groups as much as possible. This serves two purposes: Students experience first-hand the potential and limitations of the communication technology under review, adding to the authentic nature of the task (principle 5), and the process of group work is made explicit to assist class members in reflecting on their educational experiences in using the technology. In other words, students are able to use examples from immediate experiences to illustrate shortcomings of the software under review. Scheduled team meetings with the instructor during Phase II provide a focal point requiring students to articulate their own progress as a group. The structure of these meetings model authentic interdisciplinary design team environments.

Phase III (4 weeks) Project teams from Phase II are recombined into five new groups using a jigsaw method where membership in each new design team includes an "expert" from each of the earlier project teams. Each team is assigned the task of producing a design for Virtual-U™ software. This conferencing tool continues to be used by teams to coordinate group activities. However, face-to-face meetings are necessary during Phase III because this conferencing tool does not lend itself to design tasks that typically require shared space, drawing objects, and asynchronous communication. The jigsaw model creates a pattern of social interaction requiring that each member share expertise throughout the process of constructing new understandings (principle 4). This new knowledge is then applied to the particular task at hand, the design of virtual space for educational purposes (principle 6). Students also reflect on experiences of using the virtual space to accomplish their assignment during Phase II (principle 1).

At the end of Phase III students publish their final work for other class members to view and each group presents a design for the Virtual-U™ supported by the five design perspectives. The collaborative efforts of students in the course are expanded by inviting members of the Virtual-U™ design team and interested faculty to the presentations. Functioning as software design teams, students are required to creatively and succinctly articulate their designs and theoretical support for their decisions, and defend their work through open questioning by other class members and visitors.

Reflections on Design

The constructivist principles reflect the design of this course in several ways: 1. Students engage in authentic activities in terms of both course content and process, 2. Critique and design task activities contribute to shaping of communication tool design, 3. Students are aware of the importance of their role, 4. The structuring of design teams to accomplish these tasks is equally authentic since effective design requires that the team advance beyond the sum of the pieces, and 5. Group dynamics and activities are structured according to authentic interdisciplinary software design environments, and expectations within that working context are modeled by the instructor.

3. Introduction to Statistics

Introduction to Statistics is a required course for many students from a wide range of disciplines and acquired levels of education. The course emphasizes "the collection, description, analysis and summary of data, including concepts of frequency distribution, parameter estimation and hypothesis testing" [Weldon 1997]. The intention of placing an introductory statistics course in an asynchronous collaborative environment is to give students the freedom to work at their own convenience and to develop an understanding of statistical concepts and strategies through discussion and work with other students.

Organization and Course Structure

Presentation of the course is in two modes -- offline, consisting of printed course materials and required access to a statistical software package, and online via the Virtual-U™ conferencing system. All instructor, Tutor-marker (TM) and student interaction takes place in several conferences: private study group conferences, cafeteria conferences, the test and exam conference, the online classroom which houses feedback from the Instructor or TM, the Instructor/TM office hours, and a help conference. The course is designed to direct small study groups to discuss the most important issues and to report the outcome of the discussions to the TM and Instructor. At the beginning of every week (for 13 weeks), the session plan is posted in the online classroom. In every weekly session, individual studying tasks are to be completed before students take part in online discussions. Three contributions are expected from each student and, on a rotating basis, a student from each study group moderates the discussion and reports to the Tutor-marker at week's end. Feedback on moderator reports, marked assignments, and an introduction to the proceeding session is made in a public conference. The next section presents the instructional design of the course in terms of constructivist principles of learning. This is followed by design considerations.

Implementing Constructivist Principles

Principles 1 and 2: The weekly assignments and tasks address these principles by having students perform individual tasks, then bring their understanding to a group. The group discussions enable students to provide feedback and assist each other in analyzing and reporting data. Though opportunities are made for students to gain a rich understanding of statistics through work with others, groups differ in how they handle this intent. In some groups, students work on separate parts of the group assignment and the moderator is responsible for pasting the pieces together, while in other groups, more time is allowed for feedback, refining, and discussing topics. However, discussions tend to focus on completing the group assignment rather than providing mutual support or completing individual assignments.

Principles 3 and 4: The collaborative environment itself did not seem to contribute to the building of a rich and broad semantic network of information. Though many conferences contain numerous messages, the quality of the messages show that many discussions did not draw on individual areas of students' own expertise and understanding. Messages appear to lack depth and students had difficulty in supporting the construction and distribution of knowledge and understanding through their collaborative work.

Principle 5 and 6: Discussion and responses to text-based and conceptual questions form the basis of evaluation for group assignments. Individual assignments consist mainly of text-book questions, with the exception of a project where students are asked to collect, explore, analyze data and write a report on the process and findings. Students are provided with opportunities to learn effectively through authentic settings in that the conferences allow them to share ideas and understandings with their fellow "researchers". Furthermore, students practice in

exercises that assist in the drawing of general knowledge and application to other contexts. The individual project is valuable as it provides an authentic setting where students perform a complete research study.

Reflections on Design

While the use of an online environment for this course does embody many of the situated learning principles, students do not appear to take full advantage of these opportunities to enrich their learning. The variability between student backgrounds may contribute to difficulties relating to one another. Furthermore, the maturity level of students may be a factor. First-year students are less experienced in learning in a group environment and in taking responsibility for their own learning. Online discussions could be improved through explicit instruction on working together, in addition to tightening the direction of group discussions, increasing motivation, and having students understand the purpose of the group discussions.

The current structure of group assignments could perhaps benefit from more direction in working together. For example, in lieu of weekly group assignments, students could be assigned projects where data would need to be collected, discussed, analyzed, and reported. The advantages of this are: 1. students could build upon the knowledge and understanding the students gained from individual work, 2. students could take advantage of the diversity in backgrounds and thus produce very interesting studies and improved group dynamics, 3. group projects could then be mounted and shared with the entire class, and 4. students would be drawing upon the general knowledge gained from their individual studies by applying it to an authentic situation. Some students are anxious about taking a statistics course. Improved interactivity would not only bring deeper understanding of the material, but it would also benefit students by allowing them to converse with and obtain support from their peers.

Conclusion

The three courses are different in content, presentation and student types: working professionals participated in an online writing course, fourth year students in a hybrid course focusing on software design, and students from a range of disciplines and educational levels in an online introduction to statistics course. Course designers should consider all of these variables when using this very flexible medium. Upon reflection on the course designs, it seems that the more constructivist principles that are embedded in a design, less re-designing is needed. Implementing an appropriate design takes advantage of student diversity and although content and students may differ, courses would benefit with the implementation of some principles of constructivism. Looking at design features using general principles of situated learning that assess the "fit" between instructional design features, the general "type" of students registered in the courses, and the nature of the content is a productive approach to online course design.

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FI/FD LEARNING STYLE, GENDER, MATH ACHIEVEMENT AND COMPUTER ANIMATION

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Abstract: The major purpose of this study was to compare the learning effects of four courseware versions, namely, animation+text, animation+voice, animation+text+voice, and free choice. Subjects' personal characteristics: FI/FD learning style, gender, and math achievement were also examined in this study. Study results indicated that subjects performed significantly better on the posttest in the animation+text+voice version, which was also the favorite interface design chosen by most of the subjects. It was also found that the animation+text+voice interface effect was only strong for FI subjects, males, or students with low math achievement.

In a relatively short period of time, computer technology has been increasing its impact on the ways of teaching and learning. Benefit from the technological advancement, the instructional softwares developed and used in computer assisted learning have achieved great improvements. One of the most significant changes is the widespread using of computer animation. Integrating text, sound, and computer animation into instructional softwares, the presentation effects are maximized.

Dual-code theory provides theoretical support of the uses of verbal (such as text) and nonverbal (such as animation) codes in lesson presentations. Studies performed by Mayer & Anderson (1991,1992) and Mayer & Sims (1994) confirmed the dual-code theory. Their studies revealed an instructional implication that computer animation and oral narration are most effective when they occur contiguously in time or space. Some other studies also verified the positive learning effects under certain circumstances concerning the use of computer animation in a courseware (Park & Gittelman, 1992; Rieber, 1991; Baek & Layne, 1988; Baggett, 1984). However, there are still some questions remain to be answered.

Although previous studies indicated that the learning effects were better when combining computer animation with text or oral narration, few studies were conducted to examine these three factors simultaneously. The truth is that we do see lots of applications of computer animation, text, and oral narration altogether as major presentation strategies in current multimedia coursewares. Thus, the first question tried to be answered in this study was: What was a more effective way in terms of the using of text, voice, and computer animation to conduct the learning content? Text only? Animation only? Text plus animation? Voice plus animation? Text plus voice and animation? Which one will contribute more to the understanding of the knowledge content and therefore enhance the learning outcome? In other words, the first purpose of this study was to compare the learning effects among three major presentation methods, namely, animation plus text, animation plus oral narration, animation plus text and oral narration in a computer assisted instruction courseware.

The second question this research tried to answer was: To whom the presentation effects was maximized? The study of Mayer & Sims (1994) revealed that the contiguity effect (computer animations and oral narrations presented simultaneously) was strong for high- but not for low-spatial ability students. What about other individual characteristics? The current study tried to examine more individual differences which affect students' learning from visual and verbal instruction in a computer environment. The following three personal characteristics: FI/FD learning style, gender, and math achievement were examined in this study. Thus, the second purpose of the current study was to find out if significant differences of learning effects existed between FI and FD subjects, between males and females, or among subjects with different math achievement in a multimedia learning environment.

Most of the previous studies concentrated on the issues of learning effects of various presentation interfaces. Few of them examined the subjects' affections toward the various interfaces. Therefore, the third purpose of the current study was to find out what kinds of interface designs were the subjects' favorite.

METHODS

SUBJECTS And INDEPENDENT VARIABLES

The subjects were 175 7th grade students who came from 8 classes of a rural junior high school in Taipei county of Taiwan.

Before the experiments, an embedded figure test was administered to roughly 330 students of the 8 classes to determine their FI/FD learning style. Students whose embedded figure test scores were within top 25% of each class were identified as FI subjects. Those with test scores within the lowest 25% of each class were identified as FD subjects. Totally, 175 students were selected to participate in this study.

Among the 175 subjects, 89 subjects were in the FI group (50.86%). Their average score of the embedded figure test was 11.73. The FD group consisted of 86 subjects (49.14%), and their average score of the embedded figure test was -1.68. Significant difference of the average score was found between the FI and FD groups from an ANOVA analysis ($F = 705.63$, $p<.001$).

Based on the math final grades of a previous semester, subjects were divided into three groups with different math achievement. Students whose math scores were among the top 25% of each class were classified into the high math achievement group. There were 50 subjects (28.57%) in this group with an averaged math score of 85.32, based on a 100 scale. Students whose math scores were within the lowest 25% of each class were classified into the low math achievement group. There were 57 subjects (32.57%) in this group with an averaged math score of 27.02. The rest students of each class were classified into the average math achievement group. There were 68 subjects (38.86%) in this group with an averaged math score of 63.79. The average math scores among these three groups were found significantly different ($F=346.29$, $p<.001$).

Among the 175 subjects, ninety students (51.43%) were males, while eighty-five students (48.57%) were females.

LESSON CONTENT And COURSEWARE VERSIONS

The instructional content of the experimental courseware used for this study was "Forces" and "the Resultant of Forces" in Physics domain. Forces and the Resultant of Forces were knowledge with traits such as motion, trajectory, and abstractness. Understanding of these kinds of concepts could be enhanced by the implementation of computer animation in a courseware (Park & Hopkins, 1993; Rieber, 1991). The lesson material was divided into five major parts: 1) Force Equilibrium, 2) the Motion of Forces, 3) the calculation of the Resultant of Forces, 4) the introduction of the resultant of forces by using a parallelogram, and 5) review and practice questions. All instructions were presented at an introductory level. Approximately thirty minutes were needed to complete the lesson.

Four courseware versions were created for the purposes of this study. These four versions were: 1) animation+text, 2) animation+voice, 3) animation+text+voice, and 4) Free Choice version. For the Free Choice version, subjects were able to choose their favorite interface design from the three versions stated above. Differences among the four versions were only on the using of presentation media. The instructional contents were the same for all versions.

In this study, computer animations were mainly used to explicit the moving trajectory of a stationary object when pushed by two forces either in the same or in the opposite direction. For example, one of the instructional screen was that when an object was pushed by two unequal forces from opposite directions in a line, the object would start to move toward the direction of the larger force.

Subjects from the eight classes were randomly assigned to one of the four lesson versions in the experiment.

DEPENDENT VARIABLES

A ten-item paper-pencil type of posttest was administered to subjects to measure the learning outcomes. A questionnaire developed by the researcher were used to collect the data concerning subjects' affection toward the interfaces. Subjects took the posttest and filled the questionnaire immediately after they completed the instructional lesson. It took about 10 to 15 minutes to finish the posttest and the questionnaire.

RESEARCH QUESTIONS

Four research questions were issued in this study. They were:

1. Were there significant differences of learning effects among groups of four courseware versions?

2. For each courseware version, did a) FI, FD subjects, b) males and females, or c) three groups with different math achievement differ on the posttest scores?

3. For a) FI subjects, b) FD subjects, c) males, d) females, e) high math achievement students, f) low math achievement students, or g) average math achievement students, did their posttest scores have significant differences among four courseware versions?

4. What was the favorite interface design for the subjects?

RESULTS AND DISCUSSIONS

A significant effect was found for the presentation interface, $F=4.20$, $p<.01$. Subjects in the animation+text+voice group scored significantly higher on the posttest (Least Square Means, LSM=71.47) than those in the animation+voice (LSM=64.01) or the animation+text (LSM=59.72) groups. No significant difference was found on the posttest scores between the animation+text+voice and Free Choice (LSM=69.40) groups. When subjects in the Free Choice group were asked, "During the lesson, which type of presentation interface did you use most of the time?" Thirty-two out of forty-three (74.4%) subjects indicated that they used animation+text+voice type most of the time. Which might be the reason that no significant difference was found between animation+text+voice and Free Choice groups. Based on the results stated above, it could be concluded that among the animation+text, animation+voice, and animation+text+voice interface designs, the animation+text+voice type achieved the best result in terms of learning effects. Table 1 presented the results of ANOVA analysis on the learning effect for different groups of subjects.

Table 1: Results of ANOVA on the posttest scores

Independent Variables	DF	SS	MS	F	Prob>F
Courseware Versions	3	3521.76	1173.92	4.20	.0069*
FI/FD	1	2032.47	2032.47	7.27	.0078*
Gender	1	2055.85	2055.85	7.36	.0074*
Math Achievement	2	8426.21	4213.11	15.07	.0001*

*reach a significant level

Table 2 presented the analysis results relevant to the learning effects for FI/FD, males and females, or subjects with different math achievement in each courseware version.

Table 2: Results of ANOVA on posttest scores for subjects groups in each courseware version

Courseware Version	Group	DF	SS	MS	F	Prob>F
Animation+text	FI/FD	1	116.06	116.06	0.46	.5027
	Gender	1	1.17	1.17	0.00	.9463
	Math	2	3282.91	1641.45	6.47	.0037*
Animation+voice	FI/FD	1	1.72	1.72	0.00	.9463
	Gender	1	495.00	495.00	1.32	.2575
	Math	2	6586.62	3293.31	8.79	.0007*
Animation+text+voice	FI/FD	1	1007.19	1007.19	4.13	.0490*
	Gender	1	1965.54	1965.54	8.06	.0072*
	Math	2	1022.73	511.36	2.10	.1366
Free Choice	FI/FD	1	2417.86	2417.86	9.74	.0034*
	Gender	1	766.05	766.05	3.09	.0869
	Math	2	798.64	399.32	1.16	.2133

Dependent Variable: Posttest Score
*reach a significant level

The study results shown in Table 1 indicated that FI/FD learning style was an effective factor on the posttest. It was found that FI subjects scored significantly higher than the FD subjects on the posttest, $F=7.27$, $p<.01$. However, as shown in Table 2, for the FI and FD subjects, their posttest scores only differed significantly in the animation+text+voice version ($F=4.13$, $p<.05$), or Free Choice version ($F=9.74$, $p<.001$). No such difference was found either in the animation+text version or in the animation+voice version. Study results shown in Table 3 revealed that for FI subjects, there were significant differences on the posttest among four courseware versions, $F=3.11$, $p<.05$. FI subjects in the animation+text+voice group or in the Free Choice group scored significantly higher than those in the animation+text group or in the animation+voice group. No significant presentation effect was found for the FD subjects. Since most subjects in the Free Choice group chose animation+text+voice as their major presentation interface, it could be concluded that the animation+text+voice presentation effect was only strong for the FI subjects, but not for the FD subjects. The Least Square Means of posttest of each subject groups in the four courseware versions were presented in Table 3.

Table 3: The Least Square Means of posttest of each subject groups in four courseware versions

Group	Animation+text	Animation+voice	Animation+text+voice	Free Choice	F	Prob>F
FI Subjects	70.00	70.91	80.45	81.36	3.11	.0305*
FD Subjects	44.76	58.57	60.91	58.18	2.55	.0616
Males	62.11	64.17	78.19	74.40	3.00	.0351*
Females	54.80	65.79	63.19	63.68	1.23	.3037
High Math	76.67	81.67	83.85	86.92	1.23	.3079
Low Math	40.00	44.00	60.63	60.77	5.79	.0017*
Average Math	65.00	65.24	70.00	63.89	0.30	.8282

*The posttest scores of this group subjects were significantly different among four courseware versions

Significant differences on the posttest score were found between males and females, $F=7.36$, $p<.01$, as shown in Table 1. The male subjects performed superiorly to the female subjects. However, only under the animation+text+voice interface, the posttest score differences were existed between males and females. No significant difference on the posttest scores between males and females was found either in the animation+text, the animation+voice, or the Free Choice versions. Study results also indicated that only for males, the significant differences on the posttest among the four courseware versions were found, $F=3.00$, $p<.05$. Male subjects in the animation+text+voice or the Free Choice versions performed significantly better on the posttest than those in the animation+text or the animation+voice versions. There was no significant difference of the posttest score for female subjects among the four courseware versions. It was concluded that the animation+text+voice interface effect was strong only for the male subjects, but not for the female subjects.

Significant differences were also found on the posttest among the three various math achievement groups, $F=15.07$, $p<.001$. Subjects with higher math achievement also had better posttest scores. However, such results were only found in the animation+text or animation+voice versions, but not in the animation+text+voice or the Free Choice versions. From the data shown in Table 3, it was noticed that

only subjects with low math achievement had significant different posttest scores among the four courseware versions, $F=5.79$, $p<.01$. No significant posttest score difference was found either for subjects with high math achievement or for subjects with average math achievement. Low math achievement subjects performed significantly better in the animation+text+voice or the Free Choice versions among four courseware versions. Apparently, the animation+text+voice interface effect was only strong for low math achievement students but not for high or average math achievement students.

Given every possible combinations of the presentation methods among text, voice, and computer animation, subjects in the animation+text, animation+voice, and animation+text+voice groups were asked: "If you could possibly choose the presentation interface, what is your favorite design?" Seventy-six out of the 131 students (58%) indicated that they preferred animation+text+voice type. Thirty-five subjects (26.7%) said they would choose animation+text as the presentation interface. In the Free Choice group, subjects were entitled to change their interface during the lesson. However, only one out of 43 persons said that during the lesson, he changed the presentation interface frequently. The rest forty-two subjects chose one presentation way and stuck with it throughout the lesson. Thus, it was not surprising to find that 83.7% (36 out of 43 subjects) of the subjects indicated that they didn't appreciate particularly the choice of freedom of the presentation interfaces in an instructional lesson.

GENERAL DISCUSSIONS

When investigating animation effects in learning, lots of studies focused on the comparisons of the learning effects of computer animation (with or without text) to the static graphics (Rieber, 1996; Park & Gittelman, 1992; Rieber, 1991; Rieber, 1989; Baek & Layne, 1988; Rieber & Hannafin, 1988). Some researches studied the presentation order between computer animation and verbal narration (Mayer & Anderson, 1991,1992; Mayer & Sims, 1994). The present study examined three media factors, namely, text, voice, and computer animation because it is more conformed to the current presentation strategies applied in CD titles nowadays. Results of the present study revealed that concurrent using of text, voice, and animation together in an instructional interface had significant better learning outcome than the using of animation with text or animation with voice. Animation+text+voice design was also the favorite interface chosen by most of the subjects in this study. On the practical side, these findings are worthy of consideration when integrating multimedia into the presentation interface of a computer assisted instruction lesson.

For the question, "To whom the presentation effects were maximized?" the results of this study indicated that the animation+text+voice effect was strong only for FI subjects, males, or students with low math achievement, but not for FD subjects, females, students with high or average math achievement. All the subjects had low prior experience with the instruction content. The findings contribute a fuller understanding of the learning in the multimedia environment.

It was unexpected to find from the present study that few subjects preferred the free choice of presentation interfaces. Due to the limited choices of interface designs provided by this study, further research is recommended to clarify the issue.

The results of this study also indicated that the subjects in the animation+text+voice version got the highest posttest scores. Besides, FI students performed better than the FD students. Male subjects scored higher than female subjects. In addition, students with higher math achievement had better performance on the posttest than those with lower math achievement. However, careful generalization should be concluded because of the nature of the knowledge content instructed in the experimental lesson. Traditionally, Physics is a more spatial and male oriented field. Subjects' learning outcomes may be influenced by the knowledge domain. Therefore, further researches of different fields of learning content are also recommended.

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Using Web Conferencing to Promote Ownership in Distance Education Coursework

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Abstract: Distance education has traditionally been most effective with students who show exceptional levels of motivation, self-confidence and autonomy. But the real challenge for distance educators is to encourage these qualities in more typical learners. By adding a web-conferencing component to our longstanding rural distance education program, we are able to promote a greater degree of interaction and ownership among the teachers who take our courses. The article describes our use of Alta Vista Forums in our courses and highlights the ways this technology helps improve the level of participation and control exercised by class members.

One of the most important developments in education in recent years is a shift in focus from what teachers are doing to what learners are doing. Increasingly, educational research and practices are moving from a didactic model of instruction toward a student-directed model. Wagner and McCombs [1995] described student-directed instruction as "a conceptual framework for describing how a learner understands his or her world and approaches the process of learning inside and outside of school." A basic principle of student-directed learning is the fundamental importance of students' taking ownership for their own learning. Promoting ownership--encouraging learners to make choices and take responsibility for the direction of their own education--is an essential component of effective instruction [Langer & Applebee 1986].

Ownership is closely linked to "students' sense of personal goals and products" [Langer & Applebee 1986]. Many terms have been used to describe the attributes of ownership, such as goal setting, self-monitoring, self regulation, learner control, critical thinking skills, intrinsic and extrinsic motivation, communication skills, and personal autonomy [Honebein et al. 1993, Oliver & Reeves 1996, Pintrich & DeGroot 1990, Risenberg & Zimmerman 1992, Savery 1996, Steinberg 1989, Zimmerman & Schunk 1989]. Whatever the specific focus of each of these terms, their application to learning shares a common premise: understanding and optimizing the factors that support and encourage students to learn for themselves is a crucial element of successful instruction.

A strong sense of ownership is an especially critical factor for students in distance education settings. Learners who are not in close physical proximity to their instructors must often work more independently than students in traditional settings [Kember 1995]. In fact, many distance educators attest that independence and a strong sense of ownership are essential predictors of success in distance education students. As Riddle [1994] has observed, instructors describe the type of students likely to be successful in distance education settings as adults who are comfortable with less personal attention from instructors. Such students can more easily overcome the discomfort caused by the lack of direct instructor contact by means of their own intrinsic motivation to succeed [Riddle, 1994; Wagner & McCombs 1995].

But distance education must also cater to the needs of students who may not have such a strong natural inclination to ownership and self-sufficiency. Students who enroll in distance education courses do so because of considerations of schedule, location or availability, not because their learning styles or motivation make them good candidates for distance learning. Thus, instructors and instructional designers must make a deliberate

effort to promote and encourage ownership among students, especially for those who may be used to teacher-directed instruction where they make few choices for themselves. The ability of a program to build ownership may well mark its ultimate success or failure among the learners who do not present exceptional levels of independence and self-sufficiency.

Web-based conferencing is an internet tool that has enormous potential for increasing ownership and self-sufficiency among students, as it helps move course content from teacher-focused technologies such as two-way video to a cooperative learner-centered environment. We are incorporating web-based conferencing into our long-running distance education program to improve the participation and self-direction of students who have traditionally felt isolated or uninvolved in remote courses. In the next section we describe our program and discuss some of the obstacles and limitations involved in promoting ownership in courses we deliver at a distance. Then we describe the use of a web-conferencing tool, highlighting some features that are critical to promoting ownership.

Description of the Collaborative Teacher Education Program

For the past ten years the Collaborative Teacher Education Program (CTEP) at Indiana University has been offering distance education coursework to in-service teachers in rural communities throughout Southern Indiana. Cohort groups of 15-35 teachers meet for weekly classes at a central location, usually in a local high school or school corporation building. The instructors in CTEP remain at the university and provide real-time coursework through distance education technology. Over the years, the communication technologies we have used have advanced from speakerphones and the U.S. Postal Service, to computer-based audiographics and fax machines, to multi-point videoconferencing and e-mail. But one challenge that has remained constant is building ownership and personal involvement among the students in our classes.

From the start, our program has made an effort to make coursework learner-centered and applicable to teachers' everyday work situations. Teachers in our classes participate in weekly practicum activities in which they apply course concepts to the needs of students at risk in their own schools. We encourage teachers to work in school-based teams or partnerships to build a support network that does not rely on the presence of the instructor. We have structured class sessions to be learner-directed whenever possible, having teachers act as on-site facilitators to lead discussions and present material from the text rather than having the campus-based instructors do these tasks. A typical class period involves several small-group work and discussion activities, with remote instructors acting as consultants more than as presenters.

Despite such practices, many in-service teachers in our program still feel a greater degree of isolation than they are used to in campus-based coursework. Without the opportunity for casual talks with instructors after class or in the hallway, or for face-to-face consultation during office hours, the teachers at remote sites often have difficulty expressing their needs and obtaining assurance and guidance about the work they are doing. More importantly, some teachers feel isolated from their peers, especially when they do not come from the same school districts as others in the class. Without the chance to meet with others outside of class to go over homework and discuss ideas, these teachers are unlikely to fully engage the course content and often do work that is cursory or misdirected. In fact, unless they quickly establish social relationships with others in the class, the teachers tend to drop out of the program altogether. For learners who do not adapt well to such circumstances, distance education can be a frustrating and disappointing experience.

Web-based conferencing offers a powerful tool for creating a more interactive and less isolated experience for distance learners. Because it promotes content-based discussion among students, it allows learners to share their concerns and develop their ideas in a low-stress environment that they can control themselves. By adding this technology to our distance education courses this year, we are able to expand and deepen the role that teachers in our program take in directing their own learning.

A Web-Based Conferencing System

Alta Vista Forum is a WWW-hosted, asynchronous, text-based conferencing system that incorporates two key elements for discussions: "forums" and "teams." A *forum* is a collection of related information or resources that allows learners to interact on key issues and course concepts with other members of the class. There are three types of forums: "Discussion and document sharing," "Newsstands" and "Calendars." Newsstand and Calendar forums are well suited for sharing group information and scheduling class events, as they allow learners to post news items and web pages and to coordinate meetings and other events with the entire group. Discussion and document sharing forums promote content-based discussion. Learners post discussion comments and electronic documents inside hierarchical folders, each of which can contain other folders, continuing on for many levels. This allows learners to create many levels of categorization and enables each folder to be dedicated to a specific topic.

A *team* is a shared environment in which a select group of class members can work together on designated tasks. Team members interact through a "Team Vista" page, which contains forums and other resources available exclusively to team members. From the team vista page, learners can also launch "chat" for synchronous text communication over the internet. Learners can be a member of more than one team: they may belong to small work teams of 4-5 learners as well as a large team that includes the whole class. In our class we have teachers grouped in small discussion teams that change every few weeks to provide a variety of contacts as well as in project teams that stay the same throughout the semester. We also have a whole-class team that we use occasionally for larger group work.

Many of the capabilities Alta Vista Forum offers for learner interaction are especially useful for distance education. Students can post their projects, ideas, or questions from formal class sessions. They can comment on others' work and answer questions, rather than limiting such feedback to instructors. Students can also make changes or additions to the topics being discussed, or propose new issues or conversation areas. At the same time, instructors can observe learners' contributions to the discussion and make determinations about their progress and needs. Or they may comment on students' works, answer questions, or interject new questions to guide and coach problem solving. The conferencing system thus offers the opportunity for students to have out-of-class interactions in which they have a good deal of control over the direction of their learning process. Unlike e-mail, which typically facilitates communication between instructors and learners, the conferencing system ensures that learner-learner interaction is also encouraged. This interaction diminishes the isolation of distance learners by allowing them to develop a continuing relationship with instructors and peers between class sessions, just as campus learners do.

Furthermore, because it is asynchronous and text-based, Alta Vista Forum is in many ways preferable for the needs of distance learners to more sophisticated web products that offer visual and voice communication in real time. As distance learners are often non-traditional students who work and raise families in addition to going to class, they can benefit from the lack of scheduling needed for an asynchronous forum. And the simple technological configuration of a text-based web product insures that it is available to learners who may not have ready access to the latest computer equipment.

Applying Web-Conferencing to Distance Education

To take advantage of these benefits, we are integrating Alta Vista Forum into the CTEP coursework this year to provide a supplement to the live class sessions we offer by two-way video. All discussion on the conferencing system is directed toward existing course content and practicum projects: rather than using this opportunity to create extra work for learners, we use it to help improve their understanding and application of the work they do. To structure discussions, we require students to participate in three kinds of interaction each week: posting examples from their assigned projects, discussing course content, and consulting with peer teams. For all three types of discussion, the asynchronous environment provides the opportunity for instructors to observe and evaluate the contributions of class members without interrupting or influencing the interaction

unless necessary.

Posting Work Samples

An important disadvantage distance learners face is the lack of examples or models for the work they do outside of class. By having teachers post their work we give them access to a much wider variety of ideas and approaches than the instructors alone can provide. In addition to the benefit of seeing the work of others, the teachers also benefit from posting their own work: when displaying projects to peers as well as instructors, learners tend to monitor their learning process more carefully and to take more responsibility for their presentations.

Each week we have teachers post examples from their projects to a conference site. Teachers begin to work with their own project team members to discuss and select examples. Then, they post their examples in a whole-class discussion and document sharing forum. This format allows the teachers to build their own ongoing database of coursework examples, which any of them can check to see how to complete a worksheet, to find ideas for teaching one of their students, or simply to measure their progress against that of their peers.

Group Discussion

The second type of interaction is a weekly group discussion of course content. Exploring ideas outside of class and without the active presence of instructors allows learners to develop their own understandings of course concepts and procedures, rather than relying on instructors' explanations [Duffy et al. 1998]. In addition, this type of web-based discussion is likely to prompt thoughtful and deliberate comments, as participants are able to reflect upon their ideas as long as they want, in contrast to live class discussions, which require participants to be rather bold and quick to contribute.

To structure these discussions, we ask students to address specific questions or issues relating to the course content or to their practicum activities. We divide the class into small discussion teams that change frequently to allow teachers to interact with everyone in the class over time. Each week the teachers begin discussion in these teams, exploring the issues for that week and fleshing out preliminary ideas. At the end of the week, the teams post their ideas in a large-group discussion and document sharing forum, and they respond to the ideas posted by teachers in other teams. This forum in turn provides a springboard for in-class discussion at the beginning of the following week.

Cooperative Projects

The third kind of interaction also involves small groups, but in this case the teachers work in teams throughout the semester. Project teams are formed according to shared interests or circumstances, grouping teachers by school, grade level or areas of expertise. In this way the teachers in each team are able to provide helpful suggestions or experiences to other team members. Each team has its own discussion space in which members work on assignments together, share copies of their work, ask for and receive advice, or relate the week's events and offer support. The format of this interaction is decided by the group according to its own needs: instructors offer suggestions, but no requirements. The only demand is that each teacher participate actively in the team each week.

Conclusion

Distance education coursework has traditionally been more successful with students who exhibit a

strong sense of ownership: students who are independent, who are highly motivated, who have a high degree of self-efficacy, and who wish to have a high degree of personal control over life's outcomes [Riddle 1994]. The challenge for distance educators has long been to build this kind of ownership in students with all types of learning characteristics. Educational research consistently indicates that *all learners* benefit from instruction in which they are motivated, in which they exercise control over their learning experience, and in which they are accountable for their own learning outcomes [Wagner & McCombs 1995]. Web-based conferencing offers a strong new approach for promoting these variables among distance learners. By offering a range of options for interaction outside of class time, web-based conferencing can encourage students to develop a higher degree of ownership, enabling them to direct the discourse of the class, to establish ongoing relationships with instructors and peers, to make informative decisions together, and to take greater responsibility for the learning process.

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A Generative Approach to Active Information Assistants

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Abstract: We propose a general model and associated language to specify the behaviour of an electronic assistant. The range of applications we have in mind are those tasks where the system acts as an assistant for active information exchange in both directions. Examples are interactive story telling, database querying, self-evaluation or evaluation tests, collection of user profiles, intelligent tutoring, product configuration assistants, diagnostic systems or other kind of interactive expert systems. A restricted version of this model was used as the basis for a tool to generate configuration assistants.

1. Introduction

A well-known problem of the Web is to keep large quantities of data consistent and up to date. A standard approach to this problem is to reduce data redundancy and to maintain a minimal subset of the data, together with the ability to automatically generate Web pages from this compact representation. A further step in this direction is to extend this approach to generate, together with the data, applications and graphical interfaces to manage those data. As a prerequisite, a meaningful set of applications where a similar generative approach can be exploited has to be identified.

A common task for organisations is to provide users with the required information and optionally collect useful data during this interaction. Computers may play the role of assistants in this information exchange, especially in the Internet where information can be made available to customers all over the world. We propose a general model and associated language to specify the behaviour of an electronic information assistant. This model can be used to generate graphic interfaces, data and programs for specific applications, thus addressing the problem of reducing the amount of data to manage and the time required to develop a new application.

We have adopted a restricted version of this model as the basis for a tool to generate configuration assistants, a special kind of information assistant. This experience has shown that these kind of assistants can be easily generated from a suitable representation of the configuration process [Attardi et al. 98, Cisternino et al. 97]. We believe that this model and approach can be generalised to deal with other application domains.

2. Active information assistants

The metaphor we have in mind is a dialogue between two persons finalised to information exchange. One of them acts as the information assistant, the other one as the customer. If the purpose of the exchange is to inform the customer, the assistant must present information according to the customer's needs and, to this end, he may pose questions to decide exactly which information is useful. On the other hand, if the purpose of the exchange is to collect information from the customer, the assistant has to ask the relevant questions in order to gather the information conveyed with the answers. In any case the assistant takes the initiative.

We can identify two sorts of questions in this dialogue: general questions for deciding the strategy to follow in the information exchange, in order to assess the customer's needs and preferences; specific questions whose purpose is to make the user provide specific data which are to be collected.

The metaphor of information exchange is quite general and can be found in many different domains: salespersons, information desk employees, and teachers, all engage in these sorts of dialogues in the role of assistants. Computer systems play this role in many information service applications. Here are some examples:

1. *Database querying*: the system helps the user in the formulation of the correct query.
2. *Interactive story telling*: the system may prompt the user intervention in deciding how to proceed.
3. *Self-evaluation or evaluation tests*: the system proposes questions and suggests a number of possible answers; according to the answers the skills of the user are assessed by giving back a score or an evaluation.
4. *Intelligent tutoring*: the system displays educational material, proposes exercises or questions and suggests a number of possible results; depending on the answers, additional material is presented which matches the level of the pupil.
5. *Collection of user profiles*: more or less direct questions are posed to collect user's profiles; an obvious use of this is electronic commerce and marketing.

6. *Configuration assistants*: the user is guided through simple configuration tasks, such as product assembling and customisation or study plans generation; the goal is to assemble a product out of a set of predefined parts according to problem specific constraints and user requirements.
7. *Interactive expert systems*: questions are posed to collect information on the specific case, like symptoms in a diagnostic expert systems; the goal is to combine these collected data with background knowledge of the domain of expertise to produce expert advice.

3. The generative approach

The model relies on a representation of the strategy that the information assistant uses to request and present information to the customer. A rooted directed acyclic graph, called *choice graph* (CG), is introduced, which can be seen as a representation of the assistant's strategy in posing questions to the customer. Each node of the graph represents a possible knowledge state that is reached as the result of a set of general questions posed by the assistant. Successor nodes represent further alternatives in the information gathering strategy. Each node has associated specific questions that the user is prompted to answer; depending on the application, the answers can be selections from a set of items or solicited input data.

The choice graph is a suitable representation of the information exchange strategy for generating a graphic interface for the information assistant. A node of the graph is displayed as a single hypertext unit; selection buttons correspond to available options which the user is prompted to select, input boxes are displayed for data required to be input; links to other pages lead to successor nodes.

An additional component of the model is *custom functions* associated to the nodes of the graph. Their purpose may be different depending on the application: they could update a database with the new information provided, check the new information for consistency or compliance to predefined constraints, activate forward reasoning in expert systems and so on. The last, optional, component of the model is a *database of items*, objects with structure like class instances in an object oriented model. They can belong to different classes: the only requirement is that they have a unique name so that they can be identified in the choice graph. They constitute the pool of objects that can be referred to in the information exchange.

The declarative language we use to define information assistants is essentially a way to describe choice graphs. The language supports the definition of *choice blocks*, corresponding to nodes in the choice graph, which include *text* components and *interaction* components. The form of text component is simply a string that will appear as is in the graphics interface. A selection component appears as follows:

[<*cond*> =>] <*fun-name* ><*item list*> [(<*pars*>)]

i.e. a custom function applied to an *item list*, a list of items from the database identified by their unique name, optionally followed by a parameter list. For example "`Exactly[CPU1,CPU2,CPU3](1)`" could be used for prompting the user to select exactly *one* item out of a list of the three items corresponding to different CPU models. The selection can also be subject to some condition on the current state, which is dynamically tested. In a configuration application, for example, a choice block can be defined as in the computer example below.

```
Personal computer
{Nec [Motherboard, Case],          /1/
 Exactly[CPU 200, CPU 333](1),     /2/
 Atleast [8Mb RAM](2),             /3/
 OR(Game PC, Multimedia PC) =>     /4/
    Nec [CD-ROM, Sound card,
         Speakers,
         3D Video Card],
CHOICE(CRT monitor, LCD monitor)}/5/
Max cost(3000);                    /6/
```

This block description includes selection components, corresponding to constraints that are to be checked in this particular domain, specifying items that are necessarily needed and items that are needed depending on the state, i.e. the presence of other items or previous choices.

We can automate the process of generating a specific class of assistants by a means of a compiler, taking as input the item database, the dialogue description in the form of a CG, and a definition of the custom functions. The generator, written in Java [Gosling 96], produces the application programme (a Java applet), the graphical interface for interaction with the user (a set of HTML files), and a compact encoding of the CG and the database (data structures in Java), which are interpreted at run time.

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A Pattern for Institutional Collaboration: An American Strategy

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Abstract: An American Strategy Draft Mission Statement -- America's cultural heritage resides in countless resources in nature and in museums, in libraries and in archives, in architecture and in dynamic performance. Stewards of America's national collections have long contributed to the protection and perpetuation of this country's cultural heritage by their actions to collect, preserve, and interpret this rich abundance. Advances in information technology now open up a new threshold of opportunity for the federal stewards of cultural heritage to offer far greater access to cultural heritage information to a much broader American and international public by linking their digital information resources together and providing deeper intellectual access. This collective action, of cooperatively connecting federally-held cultural heritage information and making it broadly available as a public good, is called American Strategy.

Introduction

A situation has arisen that offers new opportunities for collaboration to all institutions in possession of collections of materials concerning the cultural heritage of the United States of America and the access of the American people to it. For the first time in history, our museums, archives, and other institutions can, through collaboration, greatly improve access to the materials involved not only for researchers, but for the educational community, including elementary and secondary schools. The collaborations discussed here go beyond institutional participation in joint exhibits or travelling shows. These collaborations, for the first time in history, propose to join collections from a variety of institutions seamlessly along thematic, chronological, geographic, or any other lines that the organizers decree or that the user requires. These efforts could only be accomplished with the help of the technologies which we now have at hand. This extension of access through the digitization of cultural assets will enable people of all walks of life to view objects of their heritage heretofore hidden from view. More importantly, projects which include an educational component will assist teachers and researchers to make good use of objects, many of which have lain unused for many years. This paper describes the process of one of the largest undertakings in this area and gives a historical background for its development by briefly describing previous and existing joint extended access and digitization projects. The word process, here, is highly important, as it means that this paper will not only disclose what the project is about, but *how* it is proceeding. This means that the project will be able to be replicated on large or small scale by local or state level agencies desiring to do so.

Background

If this paper is to be helpful to other local and state level agencies in developing their own collaborative digitization projects, it is important not only to highlight this one project, but also to give a sense of history to the development of digitization projects in general. A description of several notable collaborations follows. One of the best resources for information regarding collaborative projects of this nature is an Occasional Paper of the American Council of Learned Societies. Paper Number 41, entitled "Computing and the Humanities: Summary of a Roundtable Meeting", describes a meeting held in 1997 at the National Academy of Sciences in Washington, D.C. for the purposes of examining the reasons, procedures, and outcomes of interdisciplinary collaborations for sharing of digital resources [ACLS 1997]. Participants included representatives from the Computer Science and Telecommunications Board of the National Research Council, in collaboration with the Coalition for Networked Information, the National Initiative for a Networked Cultural Heritage, and Two Ravens Institute. It was an attempt to bring together computer scientists and humanities scholars to discuss how collaborations to improve access to digital items concerning our common heritage could be brought about. At the American Strategy meetings, issues like this are taken for granted because all of the institutions represented are cultural agencies that are already networked and familiar with computer applications relevant to their own operations. However, the National Academy of Sciences meeting was an historic one because it began the cooperative discussion of these issues and produced a summary document that can be referred to for historical or developmental research purposes.

The National Academy of Sciences meeting described a number of digital access collaborations. One of these was the American Memory initiative, a project of the Library of Congress. It provides access to the Library's collections of American historical information and to those of other libraries throughout the country. During the meeting, mention was also made of the ARTFL Project. This is a cooperative project of the Centre Nationale de la Recherche Scientifique in France and the University of Chicago. They now have online over 2,000 thirteenth to twentieth century French texts in the arts and sciences. ARTFL is a subscription web service. A free digital library of resource material concerning ancient history is the Perseus Project of Tufts University. The Perseus Project has produced a commercially available CD-ROM set which contains multimedia historical resource materials; however, many of their texts, maps, and photographs are available for free on the Web. One collaborative effort to produce a digital library, as well as to develop standards for one, was underwritten by the Mellon Fund. Cornell University and the University of Michigan have worked together not only to put material online, but also to involve other institutions in developing common methods and protocols for the storage and retrieval of digital material. Their collection of social history resources documents the mid-nineteenth century in the United States. The last initiative mentioned in Occasional Paper 41 is of particular interest because it was begun by the forerunner of the Getty Information Institute in collaboration with MUSE Educational Media. This project tested a method of sharing licensed material across closed networks between seven museums and seven universities. Obviously, the Getty Information Institute has experience in the area of organizing and opening access to digital cultural resources.

The name of the new project described herein is the American Strategy. This initiative may shape the future of public access to information about America's cultural heritage. American Strategy is a public-private partnership, the aim of which is to give everyone multi-media access to world cultural heritage, beginning with that of the American peoples. The project will link federal departments and agencies in exploring ways to create a prominent, coordinated electronic gateway for cultural heritage information The digital holdings of a variety of federal cultural institutions will be melded into one vast heritage resource site through the use of educational navigation tools. "In Willard McCarty's words, the Web 'is a mechanism to publish documents to be used actively by people, certainly by humanists who are compulsive publishers.' An associated need is increased awareness of digital content, which can itself be supported with information technology." [ACLS 1997:38]

Rationale

In [ACLS 1997] Edward Ayers spoke of how it is easier to produce electronic content than to effectively disseminate it. This is especially true where digital education resources are concerned. Another problem

arises, as well. The means to access digital information remain not only expensive (although the e-rate now may make things more accessible to K-12 educators) but also mysterious to many. Ayers said ". . . if we cannot get this (electronic resources) into the hands of people who want to touch the cultural heritage of the past, then I do not think it is worth the trouble. But when you have people out there with thirty students clustered around one computer on a 14.4 modem waiting for these pieces of the past to materialize before them, we are running into serious problems. And when it does materialize, if we have not equipped the teacher to point out what it might mean, then we are actually creating problems at the same time that we are supposedly creating potential." Obviously, it is necessary to provide both training and navigational tools for educators to use these cultural resources. Facilitating access to and use of the heritage resources for educators are main agenda items for the American Strategy project.

Cultural heritage, being the complex resource that it is, needs context as well as content. This is one of the most difficult things to provide on the World Wide Web, and providing that context is one of the greatest challenges which has been taken up by the American Strategy. It is essential to see this project as an attempt to build multiple levels of access to information containing myriad points of view and open to endless interpretations. This will be more than a basic inventory and gateway of digital resources not only because of its educational component, but because it will cut across many government levels and institutions. This, in itself, is highly innovative, as the interagency cooperation required is enormous. However, representatives from a large number of federal agencies have been meeting since mid-1997 for just such purposes. The point is that because a wide variety of federal agencies are involved in the preservation of objects and information regarding our cultural heritage, a large number of agencies must collaborate to provide access to our comprehensive cultural heritage. One of the most important things about this project is that it is flexible and continues to evolve as the directions it needs to take become apparent. There was an original idea, but it continues to be adapted and refined as advice and counsel is considered. The project has become a process. The history and framework of that process is discussed within this paper.

Project History

The Getty Information Institute plays an active role in a number of international projects such as the G7 Multimedia Access to World Cultural Heritage. The Institute has also been active in representing cultural heritage interests in the formulation of American policy for a national information infrastructure. Playing a catalytic role to support the federal departments and agencies to come together to consider access to heritage collections is a concern of the Institute. With that in mind, in 1997, Jane Sledge of the Getty Information Institute, began contacting individuals from a number of federal cultural institutions in Washington, D.C. Ms. Sledge attempted to interest representatives from a wide variety of federal resources in attending a meeting to discuss the possibility of a collaborative project regarding the digital preservation of our comprehensive cultural heritage. The goal, however, was not merely to host a meeting to coordinate efforts to improve access to federal information about American heritage. The goal was to develop a process to improve access to federal cultural heritage information.

Unlike some other seemingly similar projects, this was not to be a millennium project. The scope of this project would be much too large to be accomplished in such a short time. The original plan called for a demonstration project which would then be fleshed out over the next ten to twenty years. To that end, a meeting was held in mid-1997. This meeting included representatives from major cultural organizations in Washington, and was co-convened by the Getty Information Institute and the Institute for Museum and Library Sciences. The meeting facilitators made suggestions to stimulate participant follow through. It was decided that instead of focusing all efforts into simply holding another discussion meeting, a process could be developed which would reveal not only the larger scope and mission of the project , but also the impending necessity for a collaboration like the proposed one. This approach would also encourage continued commitment to the proposed collaboration. The process, as then generated, had five distinct components:

1. Articulate the vision(s) for an ideal strategy to position American cultural heritage;

2. Discover the opportunities and needs associated with achieving this vision;
3. Detail the challenges and impediments to achieving the vision;
4. Develop the strategies to bring the vision to fruition; and
5. Gain commitment to implement the strategies.

It was agreed that separating the strategy development meeting from the presentational and commitment meeting would allow for strategies to be developed, discussed, and, if necessary, revised before they were presented to a larger group of agency and department representatives. To carry the vision through to fruition, it was necessary to build a structure for relationship and collaboration among the participants. More time needed to be given to creating a common ground for collaboration and structuring people's and institution's relationship to the project. A much better understanding of the key issues, the problems which needed addressing, the specific needs and opportunities for which strategies might be developed, the potential stakeholders, and the guiding values for maintaining the process with integrity was necessary. These values might include working with the whole system and exploring the key issues in the largest sense. It was agreed that these first steps might best be undertaken through a facilitated meeting of an Advisory Committee.

The action stemming from this conversation was an invitation to members of federal cultural institutions to attend a facilitated meeting of an Advisory Committee to develop an understanding of the common ground and to articulate a vision statement. The Institute of Museum and Library Services, the Getty Information Institute, and the American Association of Museums hosted the meeting, an essential first step in articulating the challenges and opportunities for coordinated online access to federal collections and for developing strategies for action. The meeting was held at the American Association of Museums on Monday, December 15, 1997. Choosing this venue set the tone for the meeting. The A.A.M. is an umbrella organization of approximately three thousand institutions. Of the top 175 art museums in the USA, 95% are members. An interesting point is the interdisciplinary nature of the organization. The chair is held by a science museum. Even more relevant is the fact that education is at the heart of their mission. Clearly, this was an organization to stimulate progress on this project.

Attendees included representatives from the National Gallery of Art, the National Park Service, the Library of Congress, the National Archives, the Smithsonian Museum, the Armed Services, and many more. Most of the major players in the federal cultural scene were represented, as well as the Getty Information Institute. This meeting included an overview of the joint vision of the major convenors, the Getty Information Institute and the Institute of Museum and Library Sciences. Also, case studies of representative agencies' digital projects were presented by the National Archives and Records Administration about the Civil Rights Advocate Web page, the Library of Congress regarding the National Digital Library Project, and the Smithsonian Institution on the Smithsonian without Walls, "Revealing Things" project. A framework of questions about the case studies was provided to stimulate discussion about four main ideas embodied in the case studies. These ideas highlighted the importance of providing context, the need to navigate any quantity of information, issues surrounding intellectual property rights, and infrastructure for collaboration. During this meeting, two draft vision statements were produced by working groups and an agenda outline was generated for a two-day meeting, set for January 22 and 23, 1998.

Instead of having the January meetings be high level, it was decided to build upon the previous discussion by involving more people at the mid-management to senior level to elaborate upon the vision and to articulate possible strategies to bring the vision to fruition. A series of sub-groups (international positioning, partnerships, and public access) at the January meeting was charged with three tasks: to identify short and long term goals that the American Strategy would try to accomplish, to specify strategies to achieve the goals, and to propose tasks and collaborative undertakings. The groups also suggested players, key people. The framework for recommendations was structured to include a short term goal, a strategy, one or more tasks, and one or more key players. The recommendations would be discussed at a third meeting.

At these second meetings, the basic direction which the project would take was defined: it would layer resources from the participating institutions and join them via a gateway site enhanced by curriculum materials which would maximize their usefulness to all educators. A lengthy discussion took place wherein

the attendees talked about what they had and did not have to contribute to the project. Many types of organization were discussed, although the educational model prevails. During this meeting, participants also drew up a preliminary work plan. The process to achieve the goals of this plan also began to be defined. Tasks were brainstormed and research tasks were assigned. A pilot project was discussed and it was decided that a web-based effort was what all would agree upon. At that time it was hoped that the launch, or unveiling, of the demonstration project would be held in June, 1998. In an important decision regarding the launch, the committee agreed to seek White House support for the project. Another meeting was scheduled for late February at the headquarters of the American Association of Museums.

The third meeting, held on February 25, 1998, drew together senior management to review the strategies and recommendations and to make commitments for undertaking the strategies. At that meeting, the American Strategy members began to define how member organizations would cooperate to digitize and link federally-held cultural heritage resources. The members would be divided into six working groups: briefing materials, demonstration project, gateway home page, public-private partnerships census of digitized resources, and executive order. The working groups are chaired by a cross-section of the general membership who, in turn, make up the Steering Committee. The members of the working groups are contributing digitized information and staff resources to a Demonstration Project, originally planned for June, 1998, but now postponed until December, 1999. The members are also to help define infrastructure needs among agencies. For this meeting, three tasks had been delineated:

1. The group should make sure in re-examining the January meeting that its desired outcomes had been reached.
2. The group should agree upon an agenda for further action. This action would lead up to the event in June, 1998 (since postponed) and lay plans for the completion of the project in subsequent years.
3. The group should develop a structure for implementation of the plans.

During this meeting, one representative addressed the mission statement. It was pointed out that this statement looked outward and was for people outside of the committee. It was something that would explain our purpose to everyone. However, there would be cooperative "inward principles" which would guide how we worked together. These would assist with the pre-launch "political choreography" necessary for a project of this scale and scope, as well as the post-launch implementation phase. The launch was planned for a venue in Washington, D.C. and would attempt to garner as much publicity, and hence support, for the project as possible. As it was felt that an international perspective is necessary, since it is hoped that the project will expand beyond our borders, it was decided to include members of the international press. A number of issues had to be dealt with in addition to the demonstration project itself. There was an obvious need to orchestrate an early buy-in by agency heads before the event. Long discussions centered around how to get support from the administration. A schedule of general meetings was planned. Task groups planned to meet between the general Steering Committee sessions. During the Steering Committee meetings, each task group reports on the status of the efforts and discuss what lies beyond the launch for that work group.

Project Future

Since those original meetings, the project has evolved enormously. It has been realized that a properly orchestrated launch could not be effected by June, 1998 and the postponement has given the committee time to create an overall structure for American Strategy. At this time, both a business plan and a communications plan are being developed by professional consultants. A meeting will be held on July 23 to move the business plan forward. On September 17, a participants' meeting will be held to review the demonstration project, the gateway home page, the business plan, the communications plan, and other achievements. By that time, the working groups should be refined and moving towards new projects. Before Fall, 1999, the demonstration projects will have been unveiled, revised by the participants and, hopefully, publicized in both news and Web media. At this time, it is hoped that broad discussion will be initiated around the demonstration project and that corporate support for project hosting in D.C. and beyond will have been secured. Further, it is hoped that

the departments and agencies will declare continued commitment and, as such, American Strategy will begin to be reflected in some federal agency budgets. Beyond a hope for Executive Branch support, it is desirable that Congress be informed and supportive of the project and that some members will champion the project. Another important issue to be resolved will be the development of a framework to deal with any rights management and legal issues. In an effort to present a uniform face, a general presentation will be developed so that all are speaking from the same script.

By June 3, 1999, American Strategy should have identified funding strategies and developed "magnet projects" to attract foundation and corporate support. Media partners will also have been identified. Most important, though, will be the gateway which will link all departments and agencies that participated in the early meetings and, even more so, the development of enhanced cultural search and retrieval tools. American Strategy will continue to seek solutions to the problem of integrating collections databases. It will do this within the U.S.A. by beginning to involve the states in the American Strategy partnership and, later, by seeking relationships with other national infrastructures.

Summary:

As the Executive Summary of the American Strategy briefing materials states [AS 1998]:

"American Strategy is a national leadership initiative that will:

- demonstrate the commitment of national cultural organizations to encourage and facilitate public access to America's cultural heritage resources;
- emphasize the invaluable investment America's citizens have made in the preservation of their national heritage, so that people throughout the world have the opportunity to enjoy and appreciate our cultural and natural heritage;
- represent the great breadth and depth of this country's cultural and natural heritage that resides in national collections;
- respond to the public demand for access to rich and meaningful information via the Internet, ensuring ease of use and enhanced awareness of national cultural resources, for the elementary school student to the lire-long learner; and
- produce an electronic gateway to related cultural information that will continue to evolve, incorporate additions to the national collections and new interpretations of our history and heritage, and break down the organizational barriers that inhibit associations among disparate cultural resources."

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The State of Technology in U.S. Schools: Making Counts of Technology, Making Technology Count

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With widespread support from nearly all sectors of society, Federal, state and local governments and the private sector have committed to support a massive national effort to put computer hardware in the schools and get students on the information highway. The costs amount to a significant fraction to school budgets; and, given that they largely represent budget lines that heretofore did not exist, are likely to force a reallocation of resources upon the school system. Such reallocation amounts to a policy of school reform, if largely an unconscious one.

As with all infrastructure, these are far from one-time expenses. Even if we ignore the constant race to upgrade the hardware and speed up the networks, this is one infrastructure that has very substantial maintenance costs. It is not enough to donate computers to the schools, not even if they are connected by local-area-network cabling and linked to the Internet. The provision of technology infrastructure must include plans for sufficient equipment to address real student and teacher needs; software for both instructional and administrative uses; the provision of training and support for users; and equipment maintenance and replacement. Policies and plans to provide technology may not ignore these matters, if policymakers and administrators want to avoid misuse and neglect of the system and abuse from taxpayers.

In order to estimate the size of our investment, to rationally allocate our resources, we need to know where we are in this process. Policymakers don't know enough about what is going on. In one sense, we have plenty of information. National surveys of schools by the National Center for Education Statistics' Fast Response Survey System (FRSS) in 1995, 1996 and 1997 have shown a pattern of constant increase. The latest data suggest that over two-thirds of the nation's schools have some form of connection to the Internet, and nearly every school has at least one computer [NCES 1998]. And there are spot-checks, surveys and snapshots galore, as well as compilations of reports and anecdotes. As an instance, Education Week published in November of 1997 a special issue, "Technology Counts," with a substantial amount of information including state-level profiles [EW 1997]. There are also a number of reports by experts and blue-ribbon panels of diverse sorts.

But what the plethora of surveys and anecdotes mask is that we lack consistent and detailed information about many things we claim to know, and there is much of great importance for policy that we don't know at all. For instance, even in the area of counting hardware, which might be viewed as relatively straightforward, we largely lack information about where computers are located within the schools – and this information makes a difference for instruction. For another example, we are woefully ignorant about the extent of in-service training for teachers, and we don't know enough about the provision of maintenance and support.

As a nation, we are most concerned about these areas of ignorance because we fear that not enough is being done, and that so much effort that is going into the provision of hardware, software and networked resources is wasted because teachers don't know how to use the equipment for instruction.

Beyond general policy concerns, there are a number of government groups who have an urgent need for consistent, well-structured data on computers and networking infrastructure in schools. We consider here just two.

The Schools and Libraries Corporation – or whatever entity succeeds it – is facing a problem. The Corporation is tasked with the transfer of Universal Service Fund monies to the schools' service providers, in the form of discounts of up to 90% for telecommunications hardware and fees. They must do this by approving proposals

from educational organizations at all levels; they will have to do this year after year. Over the years, they must know what equipment and infrastructure the schools have, what they were funded to do last year, and what upgrades and improvements it is reasonable to ask for given what schools already have. They need data on each school to manage their program, much less evaluate its impacts.

The states and localities themselves are having to assess their own progress. An examination of state data collection efforts in this area indicates that over thirty states have collected some data in areas related to technology and networking in schools [AIR 1998]. This is a very strong base of policy interest and experience upon which to build. In many states, technology is being provided by state mandate, for a variety of reasons. Another trend is that the states are under strong pressure to report what they are doing in all areas to their citizens. Thus, an increasing number of states are issuing report cards on the performance of districts and schools on all sorts of measures, including finances, student performance and, in a couple of cases, technology. This sort of accountability can only be expected to increase.

One of the most interesting developments is the growth of private-sector (especially business, and most especially technology-intensive businesses) pressure to do more about providing equipment and software for schools, and to collect and report better and more complete information about what equipment there is. The Milken Exchange on Education Technology (http://milkenexchange.org) has devoted itself to this cause, bringing people together from the Federal government, the states and from corporate America, and also funding publications – cosponsoring, for instance, the abovementioned November 1997 issue of Education Week. The CEO Forum on Education and Technology, (which includes CEOs from technology-intensive firms as well as the chiefs of both the National School Boards Association and the National Education Association), in October 1997 published the "School Technology and Readiness Report." Among other things the report calls loudly for "...additional school and classroom data on hardware and connectivity as well as content and professional development [FORUM 1997]."

These efforts are to be welcomed; the attention to the issues and the support for action that they bring with them can only help the national debate. But the concern with private-sector efforts is that they will collect and report whatever data they can find, and not spend the time and effort it takes to coordinate state forces and collect the data that are needed carefully and consistently.

It is early yet to say how data collection needs will be addressed. One potential solution is to establish some basic data definitions and coordinate data collection efforts by the states, acting on a voluntary basis. Another possibility is to engage the help of private sector education data collection entities, since there is so much private sector interest. Yet another is to engage the Federal government. So far, NCES has relied upon sample surveys to tackle parts of this issue; it may be time, at least for matters of hardware, software and networking, to systematically collect data on the population rather than on samples.

Disclaimer

The opinions expressed here are those of the author and do not represent the official position of any agency of the Federal government.

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Interactive Display of High-resolution Images on the World-Wide Web

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Abstract: Viewing high-resolution images on the World-Wide Web at a level of detail necessary for collaborative research is a still a problem today, given the Internet's current bandwidth limitations and its ever increasing network traffic. ImageEyes is an interactive display tool being developed at Utah State University that addresses this problem by integrating caching, compression, and transmission techniques and performing global optimization across these techniques. Although much of ImageEyes is based on existing technology, it employs several innovations, including a three-dimensional, hierarchical cache and a data striping technique that tolerates lossy transmission without significant degradation to the user's view.

1 Introduction

The advent and popularity of the World-Wide Web (Web) has created an effective medium for scientists to collaborate among themselves and disseminate information to the public. Applications that require ad-hoc inspection of high-resolution images, however, are still not feasible because of current bandwidth limitations and increasing network traffic. One such application involves on-line examination of x-ray images. To be useful, doctors must be able to examine any part of an x-ray image in as much detail as the original film would allow. Ideally, when accessing an x-ray, a doctor should first see a high-level view of the whole image and then, in near real-time, be able to zoom and pan through the image, examining minute details like hair-line fractures. Other applications include on-line study of biological specimens, historical documents, artwork, and satellite photographs.

Most of the images on the Web today range in size from one to several hundred kilobytes. Although such images can fill a standard computer screen, they do not provide enough information for inspection of fine details, like bone fractures. Simply using higher resolution images, which can be several hundred megabytes in size, does not solve the problem. Current Web protocols are based on full-image transfers, irrespective of transmission speed, the resolution of the user's screen, and the availability of local storage [HTTP 1998]. Not only can full transfers require an unacceptable amount of time, but users may not have enough local storage space to hold the image data. In addition, why should the local system even try to retrieve and store that much data when only a small fraction of it can be displayed at any given time.

One possible approach is to cut a high-resolution image into smaller views that focus on predetermined areas of interest within the picture. For example, a high-resolution image of a plant might be broken down into separate views that focus on leaf venation, leaf arrangement, and its reproductive parts. Although this approach keeps the data requirements and transfer times within reasonable limits, it severely constrains the user's ability to freely explore the original image. For collaborative research, it is critical that users be able to explore areas of an image that may not have been previously considered interesting. Furthermore, extracting predefined views from high-resolution images takes significant effort and requires those who prepare the views to have an in-depth knowledge of the subject area.

Many of the restrictions and decision-making problems of the prior approach can be eliminated by fully and automatically partitioning the original image into sub-images at some zoom factor and then repeating

this process for each sub-image until all available detail is fully exposed. This would result in a complete hierarchy of views. Each level in the hierarchy would represent the full image at a specific zoom factor. Zoom operations would be implemented as hyper-links between views on different levels, whereas pan operations would be implemented as hyper-links between views on the same level. Although this approach allows exploration of the entire image, it has several serious drawbacks. One problem is a potential for excessive data transfer, even when the user's Web browser has a local cache. This problem stems from the way browsers treat image files as autonomous entities. They cannot reuse bits and pieces of previous images. For example, if a user is looking at the edge of a leaf and then zooms out to see the whole leaf, the browser requests the transfer of a whole new image, even though a portion of that image was just on the screen. Another problem is that extensive zooming and panning of an image would eventually fill the browser's cache and thereby render the cache useless as soon as the user leaves the image. Finally, since the zoom and pan operations are implemented with hyper-links, the backtracking feature (the *Back* button) available in most browsers would cause the operations to be played in reverse, which can initiate additional unnecessary data transfers.

ImageEyes is an interactive image display facility that will allow Web users to explore high-resolution images in near real-time without upgrading their computers or networks. This paper describes an overview of its design and operation and the status of work in progress.

2 ImageEyes' Architecture

Figure 1 shows a high-level view of the ImageEyes' architecture. The boxes labeled *Web Server*, *Web Browser*, and *Fast CGI Interface* and the interconnecting lines represent existing Web components and protocols [Connelly 1998, HTTP 1998, NCSA 1998, W3C 1998]. ImageEyes will use this existing technology for displaying entry-points and initiating image viewing sessions. The remaining boxes and ellipses represent the ImageEyes server and client. At the core of their design is an integrated strategy for global optimization, across its image processing, compression, communication, caching, and display techniques. The basic idea is to use observed conditions in one area to tune performance in another. For example, noisy transmission might cause ImageEyes to alter how it packages and compresses individual blocks of data prior to transmission.

The ImageEyes client software is responsible for interacting with the user, sending image requests to the server, coordinating responses, managing a local cache, and displaying the current view. We have

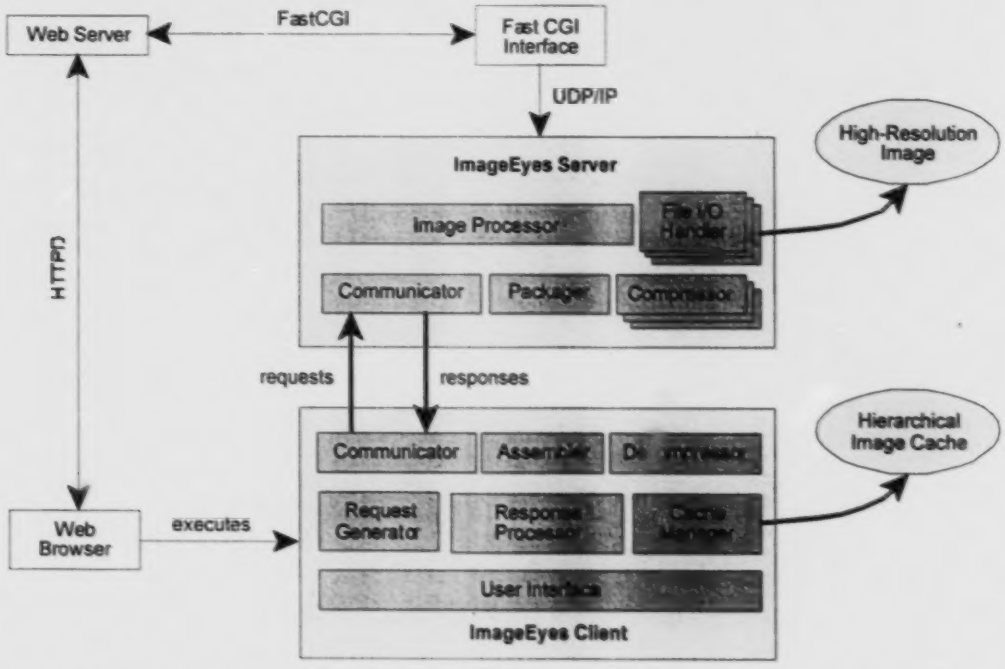

Figure 1: High -level view of ImageEyes' Architecture

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implemented version 1.0 of the client in C++ as a stand-alone application running on HP-UX® with Motif 1.2®. Future implementations include plug-ins for Netscape® and Internet Explorer® and a Java applet. Because some of these variations are intended to be downloaded at run-time, our approach is to keep the client software as lightweight as possible. For this reason, all decision-making and optimization logic resides in the server.

The client's *user interface*, displays a view of the image and allows the user to navigate through the image with various zoom and pan operations. The *request generator* optimizes the navigational requests and send them to the server via a *communicator*. Each request includes information about the contents of the client's *cache* and current network conditions. The server uses this information to decide the minimum amount of data that has to be sent back and to optimize the packaging and compression of that data.

The client's *cache* is a hierarchical scheme consisting of logical layers, each representing the entire image for a different zoom factor. At any given time, a layer may contain no data, disjoint blocks of data, or a complete image. The top layer, which corresponds to a *1x*-zoom factor, is always completely in memory. Lower layers have higher zoom factors, and therefore, represent the image at higher resolutions. The zoom factors can increase either linearly (e.g., *2x*, *3x*, *4x*, etc.) or exponentially (e.g., *2x*, *4x*, *8x*, etc.) Space for new data is allocated from a free list using a first-fit algorithm. Cache data blocks are replaced using a modified *Least Recently Used* (LRU) algorithm. Like standard LRU algorithms [Tanenbaum 1992], ImageEyes' replacement algorithm uses a queue structure to track the order in which cache blocks were last used. However, instead of using the first-fit block from the queue, the algorithm tries to preserve blocks containing data that overlaps with the requested region in the current operation. It does so by placing "in-use" locks on all such blocks. In finding space for a new data block, the replacement algorithm first releases and coalesces blocks without locks. After this process, if there is still insufficient free space for the new data, it splits locked blocks based on their potential value to the current operation. Blocks at the same layer as the current operation and with the smallest overlapping region are chosen first. When a locked block is split, the overlapping region is placed in a new block and marked as "in-use". The remaining portion is released and coalesced with other free blocks.

The client's cache can reduce the amount of data that is needed for zoom and pan requests in two ways. First, when a user moves to a new region and there are pieces of that region in the cache at the desired level or lower (higher zoom factor), then those pieces do not need to be transmitted. Their display can be computed directly from the cache. Second, when cache contains data at a higher layer for the requested region, the client only needs delta values, which are the difference between the aggregate color values of the higher layer and the exact color values for the requested layer. In many cases, these delta values fall into a small range, e.g. *-15* to *+16*, and therefore, can be packaged and compressed into fewer transmission packets.

The server's *image processor* is responsible for interpreting an incoming request and deciding the minimum data needed to satisfy that request. First, depending on the contents of the client's cache, it breaks the request up into non-overlapping sub-regions. Then, for each sub-region, it chooses how to package and compress the data. More specifically, it decides whether to send delta values or absolutes values. If the image processor decides to send delta values, it also determines how they should be striped, i.e. broken up in to smaller incremental values. Sending striped delta values allows for lossy image transmission and, in many cases, actually requires fewer transmission packets than sending absolute value. Sending striped delta values also results in a nice fade-in effect on the user's display, which gives the illusion of a quicker response time. Sending absolute values, however, is more appropriate when the delta values cover a large range and do not fit a normal curve.

The ImageEyes server is designed to support different storage formats for the high resolution images through format-specific *file I/O handlers*. At this point, we have only implemented a file I/O handler for Raw PPM, but plan to build handlers for JPEG, GIF, and TIFF in the near future.

3 Operational Overview

With the stand-alone ImageEyes client, the user starts a viewing session by executing the client program with parameters that specify a host machine and the name of an image. The client connects directly to the ImageEyes server running on the host machine and sends it an open request. The server returns some startup parameters directly to the client. With a web-based ImageEyes client, the user simply clicks on an ImageEyes link in their web browser. This causes an open request to be sent to the ImageEyes server via a *FastCGI interface* [Fig. 1] The ImageEyes server initiates a new session and returns the startup parameters to the web server, which in turn, sends them to the browser. The browser uses this information to activate the

client software. From that point on, the client software interacts directly with the ImageEyes server just like the stand-alone version.

Consider, as an example, a user who starts a viewing session for an image of a plant against a plain beige background. Although there are very few sharp edges in the image and the contrast is low, it contains sufficient detail to show hairs on the edges of the leaves. After opening the session, the server sends the client an initial view of the entire image at a *1x*-zoom factor. The client displays this data and stores it in the top layer of the cache. Next, the user zooms into the top-left corner of the image. This causes a request to be sent to the server for this region at a desired zoom factor, say *4x*. The request also tells the server that the client's cache only contains the top-layer data. The server interprets the request, reads the necessary data from the stored images, and decides on the best processing strategy. Because of the low contrast and lack of sharp edges, it would likely choose to use delta values, striped into increments ranging from *-7* to *+8*. Assuming that the network conditions are relatively good, it would also choose to use standard compression parameters and follow a transmission protocol that tolerates a small amount of loss before retransmission requests are issued.

Just after the client sends the request to the server, it starts computing the display based on the information in the cache. So, in this case, the user will immediately see a course-grain blow up of the top-left corner. The first 4x4 group of pixels will have the same initial value as the top layer's first pixel; the next 4x4 group will have the same initial value as the top layer's second pixel; and so on. The client can receive the response packets from the server at any time and in any order, as long as the request hasn't been superceded by a subsequent request. Since the packets contain delta values, the client simply adds them to the display and updates the cache. To the user, it appears as if the image is coming into focus.

Suppose the user now decides to pan a quarter of the display width to the right. The client creates and sends a new request to the server. The display is again updated based on the information in the cache. This time, the left portion of the image that is to be displayed is already in the cache at the correct layer. The right portion of the image is filled in with a course-grain blow up of the top layer in a fashion similar to the previous request. Because the request included the contents of the client's cache, the server knows that it only needs to send delta values for the right portion of the image. The server computes these delta values relative to the top layer and sends them to the client. The right portion of the image is filled in as the client receives the packets.

The user makes a final request to zoom in to the image. The display is updated from the contents of the cache so as much detail as possible is showing. Some portions of the image may contain data at the second layer while other portions may contain data at the top layer. Suppose that the client doesn't have enough free space in the cache to hold all of the data coming from the server. Some of the cache contents will be replaced based on the algorithm discussed earlier. The least important blocks are removed or split and the cache is updated with the new data.

4 Performance Evaluation

We will evaluate the performance of ImageEyes from several different perspectives. First, we will examine it on its own merits by testing both normal and worst-case scenarios for various kinds of images. The scenarios will consist of sequences of zoom and pan operations. The images will vary in size, number of colors, regularity (repetition of patterns within an image), and clarity. For each scenario and image, we will record the requests generated by the client and the sizes of the data blocks returned by the server. We will not measure transmission time, since it depends on other variables, like bandwidth and current network traffic.

Second, we will compare ImageEyes to several existing techniques, including non-interlaced images, interlaced images, predefined views, and fully partitioned images. Since the zoom and pan operations do not apply to all of these techniques in the same way, we will rate the relative effectiveness from a user's perspective. More specifically, we will look at the following issues:

- How much data is required before the user gets a glimpse of the image?
- How much data is required before the user has a complete overview of the image?
- How much storage space is required on the local system to view the image?
- What kinds of delays occur between zoom and pan requests?
- Was backtracking natural and effective?

5 Related Work

Much research has been done over the past few years on topics related to the ImageEyes project, including caching schemes, image compression, and image transmission. However, most of the work has focused on a specific area, like caching, and not on global optimization across multiple areas. Caching schemes have been extensively researched for operating systems and their properties are relatively well understood in this context [Tanenbaum 1992]. However, there are some significant differences between caching data dominated by sequential access patterns and caching images when there are three degrees of freedom in the movement through the data. Although the principle of *locality of reference* [Tanenbaum 1992] still applies, it is manifested in different ways. Nevertheless, common replacement algorithms, like LRU and NRU, and allocation algorithms, like first-fit and best-fit, can be adapted.

The areas of image compression and communication are also mature. However, current research efforts deal primarily with compression and transmission of entire images and therefore don't take into account cached data. Danskin, et al., describe an approach to image transmission that tolerates lost data with minimal distortion [Danskin et al. 1995]. Surveys of image compression techniques can be found in *Introduction to Data Compression* [Sayood 1996] and *Data Compression: Methods and Theory* [Storer 1988].

The most similar product to ImageEyes is one marketed by Hewlett Packard under the name *OpenPix Software Suite*® [OpenPix 1998]. This viewer is based on the FlashPIX™ file format [Lee 1998], which stores pre-defined views at different zoom levels. The OpenPix viewer is similar to the ImageEyes client in that the user can interact with a high-resolution image and avoid transmission of the entire image at one time. However, OpenPix seems to lack the kind of global optimization that is at the heart of ImageEyes' design. HP's application allows users to zoom in and out, but only at the layers stored in the FlashPix file. It also appears that OpenPix does not take advantage of client-side caching techniques. Zooming in and then back out results in retransmission of the original image, which leads us to believe that the data transferred from the server to the client are absolute values and not relative values based on a client's cache.

6 Summary

Because Image Eyes uses an integrated solution for caching, compression, communication, and display and because it works with existing Web technology, we believe that it will provide an effective means for viewing high-resolution images on the Web. For typical images and usage scenarios, ImageEyes should dramatically reduce the amount of information that needs to be transmitted, and thereby, provide near real-time image zooming and panning. Its worst case behavior should be at least as good as the full-partitioning approach described in the introduction.

To date, we have implemented version 1.0 of the server and client. This version includes the hierarchical caching and lossy data transmission schemes as well as an intelligent data compression technique. We are currently collecting test data to evaluate and optimize the performance of the ImageEyes system.

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A CHEMISTRY WEB-BASED COURSE SUPPLEMENT

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Abstract: A web-based supplement for a chemistry class is described which assists the students in preparing for a lab course and in writing the lab reports. A pre-lab lecture for each experiment is available from the web site as streaming video and pre-lab tests are accessed from the web site with answers sent to the instructor's e-mail. A system of bulletin boards allow each student group to complete their reports with each person in the group having a particular responsibility in the development of the report. Completed reports can then be given to the instructor in written form and on a web site.

1. Introduction

Kennesaw State University is a 13,000-student commuter university located about 20 miles north of Atlanta on I-75. It is part of the Georgia University System and offers B.S. and M.S. programs in a variety of disciplines including Business and Nursing. The Chemistry program offers a B.S. degree certified by the American Chemical Society. There are about 100 majors in the chemistry program. The average age of the students at KSU is 27 and almost all of them have jobs outside of the university.

Two of the courses that have been rather difficult to offer at our university over the years are the physical chemistry labs. There are several logistical problems associated with both of the labs.

One of the problems involves giving pre-lab lectures. Because of the expense of the instrumentation involved, we cannot have enough equipment so that the labs consist only of one experiment being done at a time. Thus there may be seven different experiments being conducted at each lab period and a pre-lab lecture is not feasible. One solution to this problem is to videotape lab demonstrations. A couple of years ago we had prepared video taped demonstrations of all of the experiments in the laboratory class. Two chemistry majors had worked with the professor to videotape crucial elements of the experiments and techniques required to satisfactorily conduct the experiments. We then had been requiring the students to view the videos in the library before coming to lab. However the students all work and planning to have time before lab to view the video tapes was sometimes quite difficult.

Another problem involved giving a pre-lab test to all the different groups after they have seen the video but before they come to lab. Since they all work, it was difficult to arrange for the pre-lab test before coming to lab so as to maximize the time spent in lab on the experiments.

A third problem involved helping the students to write the lab reports for each experiment. The students work in groups of two to three and since they also work, getting together to work on the reports and to discuss the material for the reports is very difficult.

A solution to these problems of teaching the labs is the purpose of this presentation.

2. Lab Demonstrations

A web page for the course is being written which is linked to streaming video presentations of the lab demonstrations. The videotapes are being put onto a central server and then streaming video will be used for viewing. The students can then view the demonstrations whenever they have time and wherever they have a

web connection. They can view them at home after getting off work at 2:00 a.m. or they might be able to view them at work during a break.

3. Lab Pretests

The web page is also linked to a set of lab pretests which they then take after viewing the demonstration and studying their lab manual. The tests may be taken at any time and are submitted to the e-mail account of the professor as soon as they are completed. The tests must be submitted at least 24 hours before the lab is to be done so that the professor can have the grades before the lab begins.

So now the students are prepared to come to lab to do the experiments. They come to lab, do the experiments, and arrange the data for data manipulation and plotting. Now they have to write the lab reports in their groups for submission to the professor.

4. Lab Reports

Now another problem is how do the students interact in the writing of the report since they all work and have very different schedules? The web page for the course is linked to a platform called Web Course-in-a-Box (WCB) which is developed at Virginia Commonwealth University. WCB has a section called Learning Links which, among other things, can be used as bulletin boards. WCB allows as many bulletin boards as needed and allows each to be open or restricted. The professor sets up the bulletin boards for each set of students and then sets up a different bulletin board for each experiment under each set of students. The students can then post messages, exchange files, and carry out discussions as they develop their lab reports. The final lab reports must be written in MathCad, which allows for easy mathematical manipulation and plotting of the data. Having their discussions asynchronously on the bulletin boards allows them to develop the reports and then prepare them using MathCad.

5. Other Web Connections

WCB has a section allowing all students to exchange e-mail messages and even to e-mail everyone in the class. Another section of WCB has a place for announcements that the students have to check at least weekly to see if the professor has posted something required for the labs. WCB also has sections allowing for posting of any sort of information related to the course, a section allowing the students to make their own web pages (required for the course), and areas for adding links to URL's of interest to the course.

6. Conclusion

Thus the web course supplement consists of a home web page for the course with the links to streaming video and tests and a link to WCB. Portions of this development have been used already and seem to allow the labs to proceed very efficiently. The students come to lab well prepared and the reports are among the best we have seen. We are contemplating having similar web page supplements for other lab courses. We have also begun work on having the entire lab manual – with videos and pre-lab tests – as a web manual. All video pre-lab lectures are also being put on CDs as temporary solutions to problems involving slow internet connections by some students.

COLLABORATIVE LEARNING IN WEB-BASED INSTRUCTION

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Abstract

Scholars and proponents of computer supported learning advocate the use of collaborative learning as an important component of Internet courses. Advocates claim that computer supported collaborative learning (CSCL) is an instructional strategy that can help instructors avoid the pitfalls of Internet correspondence courses that rely on information acquisition and regurgitation of rote answers that reflect low level learning. As educators transition their course from a traditional to an Internet learning a paramount concern is maintaining the essentials of a collaborative learning environment. After a brief theoretical background of collaborative learning as an instructional strategy, the panelists will describe the use of collaborative learning in three different educational contexts:

(1) an environmental education program for middle school science teachers in North Carolina;
(2) a graduate project management course for individuals working full time in organizations throughout the United States; and,
(3) a graduate course in applications of information technology for military personnel throughout the world.

Introduction and Literature Review: Panelist: Comeaux:

Collaborative learning (similar to cooperative learning) is a well-established instructional strategy in the traditional classroom. Research suggests that collaborative learning increases student motivation and achievement, promotes greater use of higher-level reasoning strategies and critical thinking, creates a sense of social cohesion and creates a productive learning environment [Abrami et al., 1995; Johnson et al., 1991; and Slavin, 1991].

Effective collaboration involves much more than students working together; they must value and perceive the importance of working actively with their peers in an interdependent structure. Effective collaboration means students think and act in ways that promote their own learning and that of others. Collaborative learning is enhanced when students are fully engaged in the activities of the class, are engaged with each other and the subject matter and take risks.

Scholars and proponents describe the essentials of collaborative learning as positive interdependent purpose and cooperative goal structure, interdependent division of labor and resources, individual accountability, and equal distribution of rewards. Students working together should know why (purpose and goals), how (procedures and tasks), with whom (group composition), the ground rules (interpersonal and group skills), and be held accountable to the group (Abrami et al, 1995, Johnson et al, 1991 and Rothwell, 1998].

Similarly scholars and proponents of computer supported learning advocate the use of collaborative learning as an important component of Internet courses. Furthermore, advocates claim that computer supported collaborative learning (CSCL) is an instructional strategy that can help instructors avoid the pitfalls of Internet correspondence courses that rely on information acquisition and regurgitation of rote answers that reflect low level learning [Dede, 1996; Harasim, 1993; Pea, 1993; and Savard et al., 1995]. As Pea [1993] argues "combinations of new computer technologies that facilitate collaboration and communication among learners can support and enhance learning, particularly distance learning" [p 288]. Dede [1996] claims that "computer-supported collaborative learning (CSCL) enhances team performance through tools for communicating each person's ideas, structuring group dialogue and decision making, recording the rationales for choices and facilitating collective activities.... Such 'telepresence' enables mentoring across distance and provides a social context that reinforces and motivates learning, in addition to preparing students for telecommuting roles in the business environment" [p. 13].

As educators transition their courses from a traditional classroom to an Internet learning environment, a paramount concern is maintaining the essentials of a collaborative learning environment. The following applications all use collaborative learning in web-based or web-enhanced instruction. Huber describes a middle school environmental education teacher training program that uses collaborative learning as an essential component in their "Students as Scientists" project. Kasprzak describes the use collaborative learning in an Internet course for training military personnel throughout the world. Finally, Nixon describes an Internet course for graduate students in a Master's of Project Management degree program that capitalizes on the essential components of collaborative learning.

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Collaborative Learning in "Students as Scientists" Project: Panelist: Huber

The "Students as Scientists: Pollution Prevention through Education" is a three year teacher training program offered through the Watson School of Education, University of North Carolina-Wilmington for middle school science teachers throughout North Carolina. The specific objectives of this teacher training project are: (1) to update teachers on environmental issues affecting North Carolina, particularly water pollution prevention; (2) to engage teachers in collaborative learning and problem-solving methodologies they can use in their classrooms; (3) to provide teachers with environmental monitoring equipment and training in the use of this equipment, (4) to educate a cadre of teacher leaders who will educate other teachers in their districts; and (5) to teach the teacher leaders to learn to use the World Wide Web and the distance learning network so that, after the institute, they can continue information gathering and networking. The project will create Web Pages that teachers may use collaboratively; they will be able to download curricular information and environmental monitoring data from the web to use with their classes.

During the summer 1997 workshop teachers from New Hanover County Public Schools conducted environmental monitoring activities on the Cape Fear River. Working with University of North Carolina-Wilmington scientists, they performed water analyses and determined dissolved oxygen and solid levels, salinity, temperature differences, and pollution indicators. Participants graphed their data using spreadsheet software and compared their data to the river monitoring activities of the Cape Fear River Project, a consortium of local industries, environmentalists, and state environmental department experts. Guided by project staff, they learned to locate environmental science resources on the Internet. Discussions focused on presenting the project's activities in lessons that reflected the national and state science education standards. Participants developed lessons that incorporated cooperative learning strategies, hands-on science inquiry, and student discourse on river use.

During the following academic year, the teachers and their middle-school students spent one day per week on the Cape Fear River replicating the summer's monitoring activities and recorded their measurements on the project's World Wide Web site. The students learned how to graph their results, use environmental science terminology to describe their activities, and analyze local environmental conditions and water-quality tests performed by the state environmental department.

During the summer 1998, teachers from Clay and Graham County Public Schools and Charlotte Public Schools, as well as additional New Hanover County teachers, attended the workshop. After completing the same objectives as outlined above, these teachers will conduct water monitoring activities on waterways in their regions with assistance from Western Carolina University and University of North Carolina-Charlotte scientists and environmental education faculty. Participants and their students will enter their data on the project's Web site and compare their results throughout the year. In summer 1999, new teachers from the four school systems will participate thus completing the three-year project funded by Glaxco foundation.

The "Students as Scientists" project emphasizes hands-on science activities which require higher order thinking and problem-solving skills. The project challenges teachers to learn to use their surrounding physical environments and real problems as teaching tools. This expertise allows teachers to better implement the new State Science Curriculum (1994) and improve their students' State Science Test scores.

The students targeted for this project are a unique group. They are constantly searching to define themselves and the world around. They must interact with their environment to learn; simply sitting passively in a classroom does not stimulate their maturing intellectual curiosity. They flourish with hands-on activities, group projects, field trips and discussion groups. Their idealism is high; they want heroes and causes and will recognize saving the water, air and land as a goal for their generation. The activities and instructional methods in this project will promote high degree of collaborative learning.

The WWW provides a forum for the presentation of environmental education concepts. "Students as Scientists" created a number of interactive web pages where teachers track the project's development and growth, and participate by using interactive forms for the posting of data to the project's home page. Furthermore, the WWW component includes modules of information that can be downloaded by teachers for integration into the curriculum and for working collaboratively with other teachers in the project. Thus, it will be possible for teachers around the world to share "Students as Scientists" with their classes.

Collaborative Learning in Military Distance Education: Panelist: Kasprzak

The Military have long been supporters of "group", "team" and other highly organized collaborative activities. The "staff" system was devised by military thinkers, and "war rooms", and "crisis action centers" are collaborative organizational structures based on military models. As electronic communication networks have developed, training and exercises have also been conducted in collaborative modes. For example, the War Gaming and Simulation Network of the Department of Defense allows military colleges, schools and training centers to conduct large simulated military exercises, with each Center playing the technical, support or leadership role that its personnel might actually fulfill in a real battle or crisis.

As distance education modes of learning are increasingly employed by colleges and universities, it is understandable that military personnel (and civilians employed by the military services) readily accept collaborative learning techniques that they already employ in varying forms in their work surroundings. At the University of Maryland University College, originally founded to support military and diplomatic personnel overseas, and at the National Defense University, the highest educational institution of the Defense Department, different collaborative learning techniques are being employed, using the Internet, video teleconferencing and educational television.

As bandwidth becomes less expensive and more readily available, the schools are conducting more experimentation with Internet video, Internet radio, Internet TV and even more exotic delivery mechanisms. Techniques include role-playing, production of group products, controlled group interactions, group study, and group use of resources.

Collaborative Learning in the Master's of Project Management Distance Learning Degree Program: Panelist: Nixon

The Master's of Project Management degree program has been offered in the traditional classroom in Western Carolina University's College of Business since 1987. The College is fully accredited by the International Association of Management Education, AACSB and the Project Management Institute (PMI). Prospective students wishing to pursue this specialized degree are usually full-time employees in business or industry, have family obligations, and live outside of a reasonable commuting distance from the WCU campus. Transitioning the traditional program to the Internet format met the educational and the personal needs of these students and industry.

The issue of maintaining high quality, student-centered learning activities, involving small group interaction and experiential learning was of utmost importance. We did not wish for this to become an Internet correspondence course. Inherent in this process is the assumption that a conscious effort be made to assure collaboration among students and faculty.

One of the most difficult tasks at first was rethinking how pedagogically sound teaching and learning concepts could be transformed into distance learning. The old adage "garbage in, garbage out" applies to this transition. If the existing course activities do not facilitate active learning, if they rely totally on the passive "talking head" lecture method, "spoon feeding" information, and regurgitation of rote answers, the technology of Internet delivery will not translate into quality teaching and learning.

Activities that have limited interaction student to student, professor to student, and student to professor have a limited value in either forum. As a graduate course, curriculum and course design processes involve rapid transition to a higher cognitive level of activities. The level and type of activity designed for the Internet was structured according to Bloom's Taxonomy of Learning Objectives. As an example, the lower-level *knowledge-based*, "students will *identify* the phases of the project lifecycle" became a higher-level *evaluative* activity in restating the activity as "students will read the scenario, determine the phase of the project lifecycle in which the activity is taking place, and *justify* that determination."

We used the WebCT classroom setup and tailored it to include the following:

- assignment page with professor introductions to lessons
- chat rooms divided into password protected "study groups" for students to synchronously discuss activities
- bulletin board with password protected "study groups" for teams to asynchronously post information, cites, material, etc. for others in the group. This included posting "hot links" to relevant web sites and on-line materials
- presentation area, a general posting area for all final group work products to be posted for all classmates to read and comment upon if desired or required by the professor.
- Microsoft NetMeeting or CU-See Me software for synchronous video and voice streaming discussions/communication
- e-mail messages and attachments
- library reserves and electronic research
- fax
- telephone
- snail mail"

The technology provided the tools to enable a higher and more consistent level of communication and interaction. Additionally, individual student input into collaborative learning activities is easily monitored...no where to run and no where to hide. Every log-in and every contribution to group activities is recorded. To date, the professors have reviewed the posted student resumes and assigned students to study groups. This is done to ensure diversity in the teams: an even distribution of experienced and inexperienced students, a mix in various industries in which the students are currently employed, a mix of nationalities, genders, and ages. This also avoids total chaos of student self-selected teams and promotes international and cross-industry interaction.

A Simple Web-based Network Management System

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Abstract

In this paper we present a software prototype for a simple Web-based Network Management System. The system has been used in practice to monitor the TCP/IP network of the University of Catania. Although there are several dedicated machines for network monitoring and management at the University of Catania (which use copyrighted software such as OpenView), we had the need for a fast and easy retrieval of the status of the University's TCP/IP network from any network access point via a web interface. The system is able to generate the status of the overall MAN subnets in less than two seconds and to report the hosts of a selected IP subnet which are up or down in less than 15 seconds. All the information is generated on the spot without data storing and extra CPU load from the server.

1. Introduction

In [Commis and Gentili 1997] a Software Prototype for a Monitor System (SPMS) for fast and efficient retrieval of traffic load on network-links from the routers of a *Metropolitan Area Network* (MAN) is described. All the information is accessed and visualized inside a HTML compliant browser. SPMS offers immediate graphic representation (GIF images) of the traffic of the monitored network connection, embedded into webpages which can be viewed from any network point, with proper authorization, inside of any web-browser. In addition to a daily view, SPMS is able to create visual representation of the traffic seen within the last 24 months as well as to generate a monthly traffic summary. SPMS has been used in practice to monitor the traffic load on network links at the University of Catania MAN.
SPMS left open the problem of a large number of network access points being installed without any kind of Network Managing control, due to the fast growing of the University MAN. This produces a large number of accesses to the network which are not registered on the local or central *Domain Name System* (DNS). In order to control the fast growing of *Local Area Networks* (LANs) and avoid unauthorized access to the MAN, we investigated the possibility of a simple network management which will then be accessible via a web interface.
In this paper, we descibe a software prototype for a *Simple Web-based Network Management System* (SWNMS) which has been used to monitor the TCP/IP network of the University of Catania.

2. SWNMS Architecture

As TCP/IP was being developed (see [Stallings 1996]), little thought was given to network management. Up to the late 1970s, there were no management protocols. The only tool that was effectively used for management was the *Internet Control Message Protocol* (ICMP). ICMP provides a way for transferring control messages from routers and other hosts to a host, and for giving some feedback about problems in the environment. ICMP is available on all devices that support IP. From a network management point of view, the most useful feature of ICMP is the echo/echo-reply message pair. These messages provide a mechanism for testing whether communication is possible between entities. The recipient of an echo message is forced to return the contents of that message in an echo-reply message. The most notable example of this is the widely used `ping` (*Packet Internet Grouper*) program.
Much alike the `ping` program, SWNMS uses the *Internet Control Message Protocol* (ICMP) echo request to determine whether a host is up or a subnet is reachable. Unlike the `ping` program, instead of checking one host at a time until it timeouts or replies, SWNMS sends out a *ping* packet and move on to the next host in a round-robin fashion. If a host replies, it is removed from the list of hosts to be checked. If a host does not respond within a certain time limit and/or retry limit it will be considered unreachable.
The University of Catania has a large TCP/IP network with over 1000 assigned IP addresses and over 40 IP subnets. With such a large number of IP addresses being used, it has become extremely time consuming to

check which IP addresses are actively in use, and which critical machines (routers, bridges, servers, etc) are reachable. Checking hosts (99% of which are unreachable) via `ping` can take hours. SWNMS was written to solve the problem of pinging N number of hosts in an efficient manner. By sending out pings in a round-robin fashion and checking on responses as they come in at random, a large number of hosts can be checked at once. SWNMS is able to check the reachability of all the MAN subnets in less than two second and to verify the status of the subnet hosts in less than 15 seconds.
SWNMS has been implemented in Perl5 (see [Wall and Schwartz 1992]) and C language. SWNMS requires an ASCII file (*ConfFile*) as input. Such a file must contain some relevant information of the MAN IP subnets to be managed. Each line of *ConfFile* refers to a specific IP subnet and contains the following fields of information

```
Subnet-IP-address    Check-point    Description
```

where:

- *Subnet-IP-address* is the IP address of the subnet to be managed. This field can be left blank for subnets which are not local;
- *Check-point* specifies an IP address used for testing the reachability of the subnet (generally the IP address of a router's interface);
- *Description* is a logical description of the subnet (generally the name of the building and/or the institution to which the subnet has been assigned).

3. Using SWNMS on the Web

Most *World Wide Web* (W3) servers provide one or more *Application Program Interfaces* (APIs) for integrating new and existing applications. The most well known of these APIs is the *Common Gateway Interface* (CGI), and although some servers additionally provide a specialized API, CGI is currently standardised and supported by all major W3 servers.
We now describe our experiences of using CGI API to deploy visual representations of the TCP/IP network status of the University of Catania on the Web.

- The *application front-end* is simply a Web browser and a CGI Perl5 script (*front-end* script) that gives back to the client a HTML page document containing the list of all the TCP/IP subnets of the University MAN and their status.
- To determine subnets reachability the *front-end* script *quickly* pings the associated *Check-point* IP addresses specified in *ConfFile*, marking with a green bullet the reachable subnets and with a red bullet the unreachable ones. The *front-end* script authomatically refreshes every two minutes. MAN subnets status is generated *on the spot* in less than two seconds.

	Subnet	● = Unreachable ● = Reachable
Rete GARR	-	●
Rete GARR Siciliana	-	●
Servizio NETTuno	-	●
Area Ricerca CNR	-	●
Campus Backbone	151.97.2	●
C.C.A.	151.97.240	●
C.C.A.	151.97.243	●
Chirurgia Generale 1	151.97.40	●
C.I.B.D.	151.97.30	●
C.I.S.C.A.	151.97.1	●
Dipartimento di Biologia Animale / Dipartimento di Biologia Generale	151.97.170	●

Figure 3.1: TCP/IP subnets status.

- The HTML page presented by the *front-end* script also contains links to the subnets IP address (if applicable) which lets the user know which hosts (of a specific subnet) are up or down.

	● = Down ● = Up
mbox.lex.unict.it	●
151.97.70.20	●
151.97.70.200	●
151.97.70.254	●
ns.lex.unict.it	●
hello.lex.unict.it	●
venere-10.lex.unict.it	●
lex-gw.lex.unict.it	●

Figure 3.2: Subnet's hosts status.

- All hosts (the ones that are up as well as the ones that are down) of the selected IP subnet address are reported using their *Fully Qualified Domain Names* (FQDNs) and are respectively marked with green and red bullets. Hosts which are up but not officially registered in a local or central DNS are reported using the IP address effectively in use. This will allow the user/operator to discover unauthorized accesses to the MAN. The Subnet status is generated *on the fly* in less than 15 seconds.

4. Conclusions and future work

In this paper we described a *Simple Web-based Network Management System*. The system has been used in practice to monitor the TCP/IP network of the University of Catania. Although there are several dedicated machines for network monitoring at the University of Catania (which use property software such as OpenView), we had the need for a fast and easy retrieval of the status of the TCP/IP network of the University from any MAN network access point via a web interface. SWNMS is able to generate the status of the overall MAN subnets in less than two seconds and to report the hosts of a selected subnet which are up or down in less than 15 seconds. All the information is generated *on the fly* without data storing and extra CPU load from the server. For the future we plan to implement a grafical interface using Java applets.

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Socrates Team Teaching on the Internet

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Abstract

This paper discusses Socrates project involving team teaching on the Internet in Business Management courses. The project exploits the connectivity of the Web to collaboratively develop online teaching materials with embedded knowledge resources, and create electronic learning communities of learners, academic experts and corporate managers. It shows how the Internet can be a potent tool for team teaching and learning.

Introduction

The Internet is opening up new possibilities of connected learning. The connectedness of the Internet makes it possible to easily communicate across organizations and geographical spaces. It makes possible a highly connected form of education. The Socrates electronic learning environment specifically uses four types of Internet connectivity in a global team teaching process. The current focus is on business management education.

Connectivity to WWW resources: In the pre-Internet world, education was largely dependent on flat text (books). Now any text can be augmented with the hyper-textual connectivity offered by the Web. Socrates ties together many information resources relevant to business students to deepen their understanding of specific topics.

Connectivity between learning peers: The Internet makes possible extended and instantaneous connectivity between learning peers, be they students in a class or managers in a multinational firm. Learners can easily communicate with each other and learn from each other (via email, listservs, bulletin boards, chat rooms) even when they are not in proximity to each other. Socrates uses these tools for learning and sharing of information to foster collaboration among teaching faculty and among faculty and students.

Connectivity between learners and external experts. The Internet makes possible access to expertise beyond what is typically provided in traditional educational systems. Learners can easily reach out to external experts (manager, community leaders, voluntary organization members, government officials at home and abroad) for guidance and expert advice. Socrates makes possible mentoring, subject matter guidance, and problem solving help from outside experts.

Connectivity between learners and instructors: Finally the Internet allows learners to engage instructors in meaningful dialogues even when they are not in the same location. This opens up possibilities of distance learning from instructors in different places. It makes possible bringing the "best" instructor learners wherever they may be located.

Socrates Web-based Learning Environment

We have been involved for over two years in the program to create the Socrates Web based learning environment that exploits these features and seeks to operationalize the Socratic method of critical questioning in Business Education. Socrates is system for creating Web based teaching. It allows faculty to quickly and easily create teaching Web sites for their courses. These sites have embedded into them 750 business education resources such on the WWW, and communication tools such as threaded discussion Bulletin Board, class email listserv, and Web based quizzer with automatic grading. Faculty can create their course Web sites without any knowledge of programming, in a few hours. They can communicate with and manage interactions among learners and outside experts. It does not need any special hardware or software, or prior experience with the Web.

Socrates also offers online teaching materials in some business areas such as international business, management, marketing, and strategy. These materials exploit the hypertext capabilities of the Web by linking each topic under discussion to multiple relevant WWW resources. The materials are cast in the form of questions that evoke critical thinking and learning. By designing learning communications strategies that are inclusive of diverse perspectives (racial, ethnic, international, gender, etc.), instructors can foster very unique and rich interactions. Sample Socrates sites can be visited at
http://www.esocrates.com/cgi-bin/socrates.cgi?coopm001
and
http://www.esocrates.com

Team Teaching

In Fall 1998, business faculty from over a dozen Universities and four countries (USA, Canada, Holland, England) are participating in developing teaching materials and team teaching with these materials. The courses covered include:

Business Policy/Strategic Management
Introduction to Marketing
Environmental Management

Each course has 15 to 25 short modules contributed to by participating members. A module is much like a chapter of a textbook focused on a specific topic. Modules have clear and focused learning objectives, hot links to relevant WWW resources, and quiz questions.

Each teaching faculty has a Socrates Web site with an electronic Bulletin Board. Faculty and students from different classes can visit each other's bulletin boards and post messages. The level of engagement is decided by each individual faculty and can vary from no engagement to joint student projects via the Internet. Faculty can also invite outside experts or corporate managers to provide inputs on course materials.

Based on our early experiences we have learned several lessons.

1. Interactivity between learners and experts or faculty needs to be carefully managed. It will not happen automatically, simply because the technology is present. Managing interactivity requires preparation, clear postings, seeding responses, follow-up reminders and evaluation.
2. Team teaching can be effective only with highly self-motivated learners and facilitators. It cannot be forced onto unwilling or unprepared participants.
3. With high degree of automation and a good collaborative development process, the time needed to develop teaching material can be reduced significantly. This makes it possible to develop materials in many different areas at a very low cost.
4. Virtual teams offer a strong bonding potential for participants. Many of the characteristics of physical teams can be replicated in virtual teams. Virtuality is not necessarily a liability in team management.
5. Team cultures emerge over time as a function of the team leader/facilitator. In virtual teams there is high dependency on the leader for coordination services. So the leader becomes a key source of cultural values and work practices.

These lessons are offered as tentative conclusions and should be interpreted with great caution. These are not definitive findings since the project is still in progress. We are sharing these as work-in-progress, and to encourage other projects into virtual team collaborations.

In the coming months several expansions of this team teaching approach are planned. First, there are plans to create teams for developing teaching materials in International Business, Introduction to Management, Human Resources Management, Accounting and Finance etc. Eventually all courses in business curriculum will be included. A related expansion is to reach out to faculty in different countries to incorporate multiple cultural and national perspectives in teaching of business issues. Socrates also plans to add online chats with authors of books, and CEOs of companies in the news to enhance the interaction among learners and experts. Other ways of incorporating innovative interactivity are constantly being sought.

The LearnShare Consortium: A Model for the Future

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Abstract: LearnShare is a consortium of non-competing companies who share training expertise and innovative practices. Evolving from CEO Rick Corry's concept of a collaborative approach to training, LearnShare combines the best training practices and programs of the partners with leading-edge distance learning technology. The result provides LearnShare members electronic access to proven training materials and enables them to participate in and benefit from research and development opportunities in multimedia and distance learning practices.

1. Introduction

The decentralization of organizations, rapidly evolving workplace technologies, and expanded information/skills requirements, are moving corporate training initiatives toward more flexible, highly specialized training delivery systems. This requires the design of interactive, customized, self-paced programs that use a wide range of communication technologies. How can a training organization meet these evolving needs on an ever-tightening training budget?

Fourteen non-competing Fortune 500 corporations found an answer to this question. They formed a training consortium to share training expertise and innovative practices—and, by so doing, improved the quality of their training while reducing their individual costs.

LearnShare, the consortium these companies created, is dedicated to sharing resources for the enhanced development of technology-based learning modules. Its members - diverse companies with proven expertise and innovative practices - enhance their competitive advantage through access to learning technologies and an effort to share their respective strengths.

Through "share sourcing" the consortium provides its members with the help they need to expand into the global marketplace. The consortium offers such assistance via the following benefits:

- cost-effective training curriculum that shares best practices
- reduction in cycle time from learning to action outcomes
- opportunities to leverage technology
- an expansive content library
- improved employee performance
- enhanced customer relationships
- extensive partnering with premier companies.

2. Background

At a vendor presentation in May of 1995, a training professional attendee asked why organizations continued to invest in training programs that they would not own and for which they continued to pay licensing and per-use fees. Other attendees expressed an interest in his concern and asked him to devise a plan. The training

professional presented his idea to his organization's management and received preliminary funding to explore the concept further with other non-competing corporations.

In October 1995, eighteen non-competing corporations were invited to attend a meeting to discuss establishing a collaborative training consortium. During that meeting, many of the attendees recognized the commonality of their training issues, and believed that a consortium could lower their training costs, expand their owned curricula, and improve the quality of their training. Moreover, they believed that they could fund this consortium themselves with the expectation that it would be self-sustaining in a few years.

Encouraged by the meeting, the training professional who initiated the consortium idea received additional support from his organization in the form of office space, equipment, and personnel. Officially created in October of 1995, the LearnShare consortium was established as a limited liability corporation in order to ensure that only non-competing organizations became members. In September of 1996, nine non-competing companies agreed to join the consortium as funding partners: each would contribute $100,000 a year for two years and would receive a seat on the Board of Directors. The idea originator (the training professional) was selected as General Manager.

At LearnShare's establishment, the consortium developed the following goals:

- to identify and partner with major corporations that have first-class training and performance practices in place
- to create a new competitive advantage for consortium members through the use of learning technology and state-of-the-art content
- to include universities, state and federal agencies, and other resources to maximize impact and output
- to achieve measurable cost savings in business education at many levels throughout the corporation

Next, the vision created by the consortium embraced not only the member's priorities, but also the needs of individual employees and the role to be played by their vendors and consultants. The consortium's vision for the year 2000 is to:

- extend learning into the workplace and home
- make learning accessible anywhere in the world, 24 hours per day
- ensure that learning applies to all individuals (at all levels and in all geographic locations)
- use leading-edge technology to deliver training
- focus learning on performance and the achievement of business goals and strategies
- foster the delivery of training in smaller segments, on demand, and with immediate applications
- improve performance through the full range of development alternatives including, but not limited to, training
- use uniform training and development tracking to both evaluate individual progress and to drive decision making
- use needs assessment to drive learning priorities and reallocate resources effectively
- ensure that learning occurs on individual, team and organizational levels
- establish partnerships with key vendors and consultants
- ensure that synergy occurs across businesses in all aspects of the learning process and in the use of resources

According to the general manager of the LearnShare consortium, "the fundamental purpose of the consortium is to serve as a clearinghouse for leading-edge employee training, and to eventually set the standard for customer training as well. The consortium will be a dynamic organization that will continually seek new partners, evaluate its effectiveness, and reconfigure accordingly.

LearnShare's culture encourages communication and trust among its members and partners. This results in the open sharing of existing training and development materials, human talent, and corporate-wide resources. Share sourcing enables the members to share existing programs, the cost of creating new materials, and solutions to common challenges. It also allows its members to collaborate on both training and non-training issues by tapping into their collective expertise and experiences. The culture is defined by a structured operating agreement

and nurtured by frequent meetings, a highly collaborative project management process, and a sophisticated communications system.

LearnShare is usually introduced into member companies through their human resources, training and development, and sales and marketing departments. These departments are the first subscribers to the process and the disseminators of information about the value of the process to other departments. Widespread member use of the consortium's programs is then promoted by linking LearnShare's web site to the companies' web sites. By accessing LearnShare's web site via its own web site, each business unit within the member companies can preview the programs and can place orders to receive training programs. As a result, the member's internal departments - financial, health and safety, manufacturing, and management - have become involved with the LearnShare concept.

3. Process

Starting its third year, LearnShare has followed an established evolutionary trajectory. Initial enthusiasm and support carried the idea forward, in rapid succession, from conception to discussion, collaboration, implementation, and funding. Once the board of directors was established, further phases of curriculum exchange and development began. Additionally, the board began the planning required for the consortium to be come self-sustaining (through grants and access fees from members' customers) within two years.

The consortium exists to advance learning based on the best available technology. At the core of the consortium's strength are best practices and shared experiences, which provide the vitality to keep the organization moving forward. Beyond the financial and structural commitment to the consortium, each member organization freely shares its best practices and expertise.

The original purpose of the consortium - to improve the quality of training and reduce overall training costs - now includes an effort to better business education by using an innovative sharing process to improve content, technology, and delivery, including multimedia and distance learning opportunities. To achieve this objective, the consortium enlisted the assistance of the educational community. LearnShare added to its membership three universities with expertise in multimedia, distance learning, and evolving technologies that could be used for training delivery and that could significantly bolster the consortium's efforts.

The consortium's member organizations are leaders within their respective industries that have demonstrated innovation in an array of skill areas. Each member organization contributes the expertise of its training professionals, as well as $100,000 per year for two years to fund the consortium's initial work. These contributions resulted in membership revenues of $1.8 million: the consortium's first two-year budget was $1.1 million. Major cost categories in the budget have been in program development and staffing.

All participating organizations agreed to the consortium's operating agreement and to provide a representative to the board of directors. The fourteen companies of the consortium employ 2.2 million people and have revenues in excess of $400 billion.

The consortium's member organizations systematically share and develop educational materials. In addition, university faculty research teams interact with inter-company program development teams as they share and create world-class training materials. Members reduce their training costs through joint funding of common learning needs and maximum use of existing resources. The consortium's size provides an advantage in negotiating volume-discount purchase rates and provides them with greater flexibility in the design and use of vendor-developed products.

LearnShare developed an organizational structure that consists of six levels: 1) Board of Directors; 2) General Manager and Administrative Support; 3) Strategic Planning and Research Support; 4) Project Manager, Sales and Marketing Manager, and Technology Manager; 5) Resource Manager and Technical Editor; 6) Project

Teams.

The board of directors consists of one representative from each of the consortium member organizations. The board meets three times per year, and each board member has a single vote. Board responsibilities include, but are not limited to, setting policies, prioritizing training projects, and approving the operating budget.

The general manager reports to the board of directors and is responsible for developing consortium membership and for maintaining its focus. The general manager's functions include development of relationships with the member organizations; leadership of the investigations of state-of-the-art delivery options; joint development of world-class skill modules; and exploration of federal, state and local government participation in and support of the process. The administrative assistant reports to the general manager, provides administrative and secretarial support, and functions as the office manager.

The director of strategic planning and research reports to the general manager and works with representatives from Arizona State University, Fairleigh Dickinson University, Ohio State University, and all other schools deemed appropriate by the board. This position helps coordinate the research and external funding initiatives established by the board.

The senior project manager also reports to the general manager. This position manages each LearnShare project team, supervises the building and maintenance of the resource library, manages the project innovation process, and coordinates the work of the member universities with LearnShare's member companies.

The sales and marketing manager reports to the general manager as well. This position manages the development and implementation of the internal marketing plan for launching LearnShare within member organizations, and also handles all negotiations with outside vendors for the LearnShare member companies.

The technology manager reports to the general manager and is the liaison between LearnShare, the consortium member organizations and vendors for all technical issues.

The resource manager reports to the manager of sales and marketing. This position manages the LearnShare resource library, directs order fulfillment, maintains resource data and provides direct product support to LearnShare members.

The technical editor reports to the senior project manager and edits all LearnShare library materials, oversees compliance to LearnShare product standards, conducts research, and negotiates copyright releases.

The project teams are managed by the senior project manager. Each project team consists of representatives from LearnShare's member organizations, an appropriate subject matter expert, and an online developer. The team members are selected from member organizations according to their skills, abilities and initiative. Each project team is responsible for the development of a specific program, identified and prioritized by the board of directors.

Headquartered in Toledo, Ohio, the consortium has branches in many other locations. The headquarters office provides a focal point for the strategic development, collaboration, warehousing, and dissemination of a full spectrum of training and development products and services to participating organizations.

The consortium management is responsible for: ensuring the strategic linkage of each team activity to organizational goals; monitoring deliverables development, timeline/milestone achievement, and budget expenditures; and, adjusting team activities to be responsive to members' needs, competitive challenges, or other factors.

The Consortium staff conducts industry analyses to determine the needs of each partner and provides accurate analyses of available products and services to meet those needs. They serve as a clearninghouse for available

products and services; provide information, orientation and demonstrations; and maintain a catalog of currently owned products and services. Initially, most of the files in the consortium's content library were text based, but the entries have been expanded to include multimedia resources and CD-ROM materials. This format allows for easy conversion to online training as new technologies emerge. Additionally, members have access to an expanding library of training resources, and by choosing programs designed in partner organizations, members have the opportunity to see the topic through another's eyes. Shared programs offer users new ways to look at challenges and to increase their expertise.

The staff helps participating organizations to acquire and implement the desired products and services or to create high-quality, low-cost alternatives. They also spearhead new product and service research efforts between corporate and university partners. Further, they seek external funding through grants and other opportunities and coordinate the use of the consortium's installed base of technological hardware.

LearnShare has established a web site that lists all available training, and includes a directory of high-quality suppliers and vendors. The site also provides information about training news and events, a chat room for individual employee input, and a "request for help" area.

The consortium is a model for integrating and aligning multiple learning and development approaches and practices designed to achieve aligned outcomes. It was designed to address an ever-expanding series of learning needs in a way that takes advantage of a uniquely networked group. The Consortium accelerates the development of learning technology through the immediate expansion of resources and provides efficient, effective design, development, and delivery of training. Its unique structure enables it to meet current learning needs and to adapt itself quickly to meet future needs.

The consortium is continually revised as it experiments with ways to integrate it's design structure with extenuating factors and to produce high-quality products.

The use of leading-edge technology to facilitate the training and development process is central to the Consortium's value to participating organizations. It's design enables it to use its members' considerable technology infrastructure and the consortium's educational partners to develop and deliver the most innovative training and development products available. Decisions about the selection and use of new technologies are driven by the research results from the university and consortium members. Research teams have been formed and are charged with:

- Determining the training and development needs of Consortium partners
- Identifying organizational learning objectives
- Defining training and development program content
- Determining content delivery methodologies
- Coordinating the program delivery
- Conducting post-program evaluation and feedback

Examples of the targeted technologies the Consortium uses or will be using include:

- Existing databases of training and development products and services
- E-mail, Internet, Intranet, and other communication channels
- Live video-conferencing technologies at members' sites coordinated through the university partners
- Person-to-computer links to key members via e-mail, computer conferencing, video conferencing, Lotus Notes, and other emerging technologies
- Beta-site testing through university partners to evaluate future products and services for consortium members

Members' immediate access to LearnShare resources provides them with leading edge technology for real-time electronic access, and it's electronic library provides information in text form, CD-ROM and photo CDs for downloading through the Internet. Moreover, the consortium is exploring ways to provide "smart" interfaces so that a training manager can be directed to specific materials that fit their particular requirements. This will

provide electronic access that has been expanded beyond simple delivery to provide on-line assistance in the development of individualized training materials.

LearnShare's available training modules include components inherent in all corporate environments and additional modules are created within the dynamic curriculum as the need arises. Any one of the consortium's training managers has access to modules within existing programs to create a program tailored to the needs of his or her audience. In addition, training managers who design their own courses from these materials can then offer these programs back to the library as enhanced material. The smart interface could also be used by individual learners to tailor their instruction by selecting modules that best meet their personal training objectives and essentially designing their own individualized courses.

4. Impact

Critical success factors established by the consortium at its inception include:

- Membership that boasts world-class organizations supporting the consortium concept
- Sharing of best practices by members
- Technologies shared by members
- Development of a market for consortium products
- Open sharing by members of individually developed and individually held training programs
- Establishing shared priorities for training programs
- Maintenance of a strong working relationship between consortium members and university partners
- Grant support obtained by the consortium to develop, implement, and disseminate program innovations

Additionally, consortium members developed a list of objectives to be met that would reduce member's capital investment through:

- Developing a critical mass of world-class partners committed to sharing resources and best practices
- Efficiently producing world-class training modules
- Providing access to world-class training modules through a digital library and state-of-the-art distance-learning technologies
- Joint funding of common training materials
- Maximizing the use of existing resources, facilities, and technologies
- Securing volume discount purchase/licensing rates
- Reducing cycle time from learning to action outcomes
- Achieving improved employee performance
- Securing greater leverage with training vendors resulting in more flexibility in the design and use of vendor-developed products and services
- Exchanging best practices training content and delivery methodologies
- Developing training program evaluative mechanisms
- Developing innovative training delivery strategies

The consortium has developed a quarterly report of all projects and initiatives to be distributed to member organizations. It includes the following information:

- All current projects
- Projects under consideration for next quarter
- Progress-against-plan report from each team
- Strategic analyses from the General Manager addressing the consortium's contribution back to member organizations

The consortium's educational partners are also responsible for validating the quality of its programs.

Although it is too early to quantify the results of the consortium's efforts, there are indicators that the goal is being achieved. One member organization estimates it is saving 30 to 50 percent on the purchase of new training materials. Another partner estimates that it has access to over 40 new programs, which - if the partner had developed them in isolation - would have cost the organization $30,000 to $50,000 each. "We recovered our investment in the first 90 days," he said. For one consortium member, curriculum developers available through the consortium have become his department's development arm.

Member relationships are key to the consortium's success, and members have commented on increased trust and a rising participation level. Members have developed a list of courses they need and are prioritizing their courses' development based on urgency. The members also have extended their relationships to include benchmarking in other business areas.

According to its members, the consortium's e-mail system is an excellent means of gaining access to information and training materials, usually within minutes or hours rather than weeks or months. By "talking" with trainers in other organizations via e-mail, employees have shared training methods, modules, and books, including those housed in the consortium's library or loaned by other members.

The increased interest in membership expressed by companies outside the consortium is another measure of its success. The consortium now looks not only for new members among non-competing and leading-edge companies, but also for value-added additions to the collective whole, and now asks potential candidates to indicate what unique qualities they can bring to the consortium to enhance the contributions to members.

5. Shared Learning

At its earliest stages, the need to create an organized, legally defined structure for the consortium became apparent. Once the consortium institutionalized all rules and procedures that defined LearnShare, participants became more comfortable with the concept, and the definition process helped the consortium focus on its purpose and direction. This also led members to realize that they needed a system to develop priorities that would allow for both democratic voting power and factors that influence choices (such as available funding and long-term benefits).

Another lesson learned was the significance of gaining acceptance and support from the highest levels of every organization involved. The visible encouragement of high-level managers strengthened the consortium and encouraged participation from individuals and their member organizations.

The original mission of the consortium focused on achieving results for its members, yet as the consortium has evolved, it continues to define what best practices are and how the consortium can serve as a model for other collaborative structures. Additionally, as the consortium takes advantage of technology that allows it to distribute its educational materials worldwide, the market for its products and services has become global.

6. Conclusion

The consortium model developed by LearnShare has tremendous potential for improving the quality of education and training in the workplace, government operations, school systems, and other organizations. The State of Ohio, a school district in Las Vegas, Nevada, and the federal government have all expressed an interest in the consortium's model. By collaborating on the design, delivery and distribution of member best practices, the consortium has created opportunities for people to become better employees through improved workplace learning and performance.

The consortium's success changed its member corporations' approach to the purchase and use of interactive training materials. What had started as a simple idea to share resources blossomed into a model for future instructional design, development and delivery.

The synergy of partnering creates timely and effective training at a lower cost, with measurable results, and with significant benefits for participants. Each member brings new ideas and new ways of looking at existing situations that are then shared with the entire LearnShare organization. The level of trust among members grows with the activity of the organization. Formerly isolated, members now feel comfortable sharing best practices and, in return, they can augment their own resources with the best practices learned from others. The wealth of information the consortium has garnered regarding organizing and succeeding as a non-competing collaborative unit can easily be shared with others through presentations and interactive opportunities.

Leadership and outcome-based interventions, combined and multiplied throughout the consortium, provide the curriculum basis for the consortium's virtual classroom of the future. This classroom can access training modules derived from leading-edge research inspired by the consortium's business and education partnerships, and it will deliver them to its participants through existing and emerging technologies. The combination of LearnShare's state-of-the-art realities and future plans will enable the consortium to create for its members the best virtual universities possible.

THE BIBLE AS LITERATURE: ELECTRONIC TEXT

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Abstract: Imagine teaching the Bible as literature in a classroom equipped with the latest in technology. What power! The Bible is open electronically; CDs are at hand to provide sound and visual effect. All of the Web exists for research. Of course, all the old standbys are still available: VCR and large screen projection, full audio for movies and tapes. What does it all mean? Today, as never before, the student of the Bible can conduct almost instant searches of the entire Bible, hear difficult names pronounced, walk in the streets of Jerusalem and tour its museums; review histories, cultures, and religions. It's all there—at the click of a button or switch.

Actual Class Session

How, though, would this translate into an actual class session? Students in my Bible as Literature class this semester found themselves on the Web the very first day of class. They accessed my home page which links to several other pages. The syllabus to the class, in fact, was accessed by the Web. On the first day of class, we looked at several points made in essays readily available to them: "The Bible as Literature" http://griffon.mwsc.edu/~crain/biblelit.html and "Five Reasons to Read the Bible" http://griffon.mwsc.edu/~crain/bible2.html. I then took them to an outline providing an overview or approach to the Bible: http://griffon.mwsc.edu/~biblelit/Overview1.html/. These essays, in themselves, were a full first day introduction.

Second Day

Following the first day, I have ready at hand outlines which I am placing on the Web for student access http://griffon.mwsc.edu/~biblelit/ These outlines exist in PowerPoint format, but I saved the outlines as HTML files and posted them to the Web. More often than not, I use the outlines rather than PowerPoint, but if I wish to slow down the process and present more formally, then the slides are available, too. I experimented with putting PowerPoint slide presentations online but chose finally not t do so because more storage space is required. Still, should I want to do so, I can click from a link on a home page and open up an actual PowerPoint presentation. The outlines provided are generally interpretive outlines of books of the Bible rather than chronological ones. Since the use of the Web for storing data for class use is a developing area for me, I'm well aware I have not tapped its full potential. Colleagues of mine are now creating carefully crafted, framed pages with multiple links that make mine look quite amateurish, but even at this level, I'm impressed with what can be stored, accessed readily, and linked to other powerful data.

Stepping into the World Beyond Classroom

I can easily step out of an outline into a Bible search engine or visit a map of the Old Testament world; through CD and Web, I can allow students to explore artifacts and current archeological sites. I can get to study guides of the Greek and Hebrew languages and mnemoics, multiple and parallel versions of the Bibles in language of choice as well as other sacred books such as the Koran or Book of Mormon, and research from all directions and levels. My home page lists King James and Revised Standard versions of the Bible with the link leading to the University of Virginia's Electronic Text page: http://etext.virginia.edu/frames/bibleframe.html This source is useful in that it also, followed, will bring students to the complete Online Library of Electronic Texts in English,

French, German, Japanese, and Latin. Choosing one of the languages, the student arrives at listings from A.D 1500 to present with 1,588 titles and 6,699 manuscripts. I've set up other pages that will lead, for example, to Bible history http://griffon.mwsc.edu/~crain/history1.html or ancient religions http://griffon.mwsc.edu/~crain/Ancient_Religion.html. These are, of course, just the beginning of what is possible.

Other Resources

Anyone using software today realizes the wealth of resources available on one CD at affordable prices. I keep *DesktopBible* by CompuWorks on my computer for simple and fast access. Another usable CD is *Jerusalem* by Multimedia CorporationCDC. This disk tours Jerusalem using Islamic, Jewish, and Christian guides. I also use *The Deluxe Multimedia Bible,* SoftKey's *The Bible: A Multimedia Experience,* and Expert's *Bible Explorer.* As for programs, I use Kirkbride's *HyperBible.* Parson's also has out Greek and Hebrew language tutors.

Conclusion

The truth is that today's world offers more for students and teachers of the Bible than any time previously. The difficult act is planning and balancing what is to be accessed and studied within the one class session. While I can move easily among technological media, I have to keep human beings in mind—and pace myself accordingly. The real joy—apart from richness of sound and vision—really lies in what can be archived and accessed. Probably the tool of choice is the search engine on the web and the search program on CDs. In class, for example, a student asked why the tribe of Dan was not recorded in Revelation; in minutes, we had seven pages of reference to Dan and the last Old Testament record: Amos 8:14: "They that swear by the sin of Samaria, and say, Thy god, O Dan, liveth; and, the manner of Beer-sheeba liveth; even they shall fall, and never rise up again." This is power that never before has existed at the fingertips!

Web-based Support for Technology Integration

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Abstract: Two Lab facilities to support faculty and teaching assistants integrating online technologies into their teaching are currently in place in the Centre for Distance Education at Simon Fraser University. This poster session presents a model to expand on the existing support provided in the Lab by introducing a web-based environment for sharing resources, ideas and experiences.

Our goal is to produce a showcase of exemplary online course designs and other related work undertaken at SFU, and provide a means for instructors to participate in shaping and sustaining this environment. This model would enable faculty and teaching assistants to investigate and explore a variety of online teaching strategies, benefit from broader and more flexible instructional support than we will be able to offer with increasing interest in online education, and participate in the advancement of online pedagogies and new technological developments at Simon Fraser University.

Adapting Teaching Strategies in a Learning Environment on WWW

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Abstract: This paper describe the application of personality theories, in especial, the Jung's theory for adapt teaching strategies to the learner. It has been used the learning and teaching environment A*ME_A*[D'Amico et all 96, 97] to validate these ideas. This environment works at World Wide Web(WWW) and was defined as a multi-agent system[Jennings & O'Hare 1996]. The information in the learner model are mapped in a set of methods and teaching process by neural networks.

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1. Introduction

AME_A has in his architecture a set of functional agents; these agents have the ability to control their own problem solving and to interact with other community members. The interactions typically involve agents cooperating and communicating with one another in order to enhance their individual problem solving and the better solve the overall teaching and learning problem.

One of our goals was to adapt teaching strategies to the student. To accomplish this goal many agents collaborate: Drive_Learning, Drive_Practice, Control_the_Results, Select_Strategy, Learner_modeling and the own Human_Agent(student). The name of the agents indicate their functions.

2. Contents of the Learner Model

There is the initial model of the individual learner which is to be regularly updated in the course of her interactions with the system. Some information carried within this model will, however, be stable or relatively stable and not subject to regular updating. Based in[Benyon & Murray 1993], we can identify three different groups of information contained in the Learner Model: Profile Model(personal learner details), Student Model(proficiency), Cognitive Model(preferences in the learning).

Table 1 outlines some characteristics which have been identified under each category and provides information on the possible value types of the attributes, how and when these values are acquired, and whether the values are static or dynamic.

In order to update the learner model, information are transmitted by the agents in the teaching process. In this phase, the Select_Strategy agent, analyze the information received and use a neural network to choose the more adequate way to teaches the learner in that conditions.

3. Personality Theories and the Myers-Briggs' Work.

Since the study of personality began, personality theories have offered a wide variety of explanations for behavior and what constitutes the person. Jung developed a personality typology that has become so popular. It begins with the distinction between introversion and extroversion. He also defined the functions: sensing, thinking, intuiting and feeling. Katharine Briggs and her daughter Isabel Briggs Myers found Jung's types and functions so revealing of people's personalities that they decided to develop a paper-and-pencil test. It came to be called the Myers-Briggs Type Indicator, and is one of the most popular, and most studied, test around.

In the first interaction the learner answer a few questions related with the learning process and some questions that was selected from the test(Myers-Briggs Type Indicator). The system has a neural network to identify the learner's personal characteristics. Based on the results we stand the

more adequate strategy for the individual learner. Then the learner process is stated. In this phase the learner's behavior is observed and the model's information are modified.

Table 1. Some Items of Information Contained in the Learner Model

Type	Item	Description	How acquired	When acquired	Modified by
Profile	Name	Free text	User input	First interaction	User
	E-mail	Free text	User input	First interaction	User
	Password	Free text	User input	First interaction	User
	Motivation	Business/ study/ recreation	User input	First interaction	User
	Background	None, poor, fair, good, very-good	User input Or System	First interaction or in the learning process	User or System
Cognitive Model	Extroversion	None, poor, fair, good, very-good	User input Or System	First interaction or in the learning process	User or System
	Introversion	None, poor, fair, good, very-good	User input Or System	First interaction or in the learning process	User or System
	Sensing	None, poor, fair, good, very-good	User input Or System	First interaction or in learning process	User or System
	Thinking	None, poor, fair, good, very-good	User input Or System	First interaction or in learning process	User or System
	Intuiting	None, poor, fair, good, very-good	User input Or System	First interaction or in learning process	User or System
	Feeling	None, poor, fair, good, very-good	User input Or System	First interaction or in learning process	User or System
Student Model	Achieved goals	Numbers	System	Continuous	System
	Didn't achieve goals	Numbers	System	Continuous	System

4. Conclusions

Backpropagation[Freeman & Skapura 1991] was the neural paradigm used by us to map the learner's characteristics in teaching methodologies. It is a good alternative when the definition of heuristics isn't so easy and there are much information in the learner model used to define such methodologies.

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Animating the Pendulum.
A Pilot Study of 7:th Grade Students.

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Abstract: The aim of our work is to study the effects of animations used in educational software. The domain chosen for this study is Physics, more specifically concepts that are crucial to understanding pendulum movement. The aim of the pilot was to investigate the feasibility of the software designed for the study as well as the methodology chosen for the test situation. Initial analysis indicates that there does not seem to be a problem with understanding that an animation can be a representation of a non possible situation. We also found that minor adjustments in the instructions for the test is needed.

1. Background

The WWW supports a number of techniques for different kind of multimedia (Shockwave, QuickTime, animated JPEG's etc.). There is much common-sense argumentation regarding the effectiveness of multimedia for educational purposes, but there is not much empirically validated knowledge. The usual argumentation follows the "more is more" path [Scaife & Rogers, 1996], that is: a picture is better than (a thousand) words, an animation is better than a still, sound is better than silence, etc.

In many computer-based instructional products animations have become popular. Unfortunately, the animations are often used to impress rather than to teach [Rieber, 1990a].

Rieber [Rieber, 1990b] shows that animations facilitate learning for children (under certain conditions) but not for adults [Rieber, Boyce, & Assah, 1989]. On the other hand there is the study by Mayton [Mayton, 1991] which suggests that the use of animations in computer-based tutorials can be beneficial for adults.

Although results from the research on animations in instructional material are mixed to some degree, there still appears to be significant potential for the use of animations in computer-based instruction [Milheim, 1993].

2. Current Work

We want to look into the effects of animations used in educational software. So far we have studied the effects of animations on university level (the principle of equivalence, a part of Newtonian physics) and found indications of a less than expected benefit from animations contra non animated illustrations [Dahlqvist, 1997]. The present study stays within the domain of Newtonian Physics but this time the students are younger (13-14 years). The part of Physics taught this time concerns the pendulum and the fact that it is only the length of the pendulum and not its weight that has an effect on the time for a period.

A program was constructed. It consisted of two parts, a short tutorial and a test. In the tutorial part short texts about the pendulum were accompanied by several related animations, illustrating the phenomenon in the text. In total there were 5 animations. The animations were all short and due to the repetitive nature of the pendulum movement the animations could simulate a longer period of movement by repeating the animations. This kept the files small, which could prove to be useful when there is a slow network connection. The texts with its accompanying animations were presented dynamically in a linear fashion, one pair after the other. The student controlled progression with an "OK"-button.

The test consisted of multiple-choice questions of different kinds: 'transfer', 'repetition' and 'true/false animation?'. The 'transfer' question was about a grandfather clock that was too fast and the language used was deliberately different from the one in the tutorial. The 'repetition' required 'only' that the student could reproduce the text from the tutorial. In the last questions the students were asked to verify if the animation shown was describing an authentic situation or not. One of three animations was correct and the other two described impossible situations (e.g. two pendulums of equal length but with different time for a period). Each question was to be rated regarding difficulty of problem and confidence in giving the correct answer.

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At the time of writing we have conducted a pilot with 16 subjects. The students worked in pairs and were encouraged to discuss with each other during the session. During the session the subjects were video-recorded from two angles: from the back (to see the screen and where they were pointing) and from the front (to see facial expressions and body language).

The main purpose of this pilot was to verify the software design and detect problems associated with the test situation.

3. Initial Results

At this point in time there are only some preliminary results from the pilot. Initial analysis indicates that there does not seem to be a problem with understanding that an animation can be fake. The subjects thus seem to be used to computer games and the fact that they do not mimic realistic situations, but rather a made up artificial world. We had some concerns about the subjects believing that all of the animations in the last questions were correct, but we stand corrected to the point that one of the subjects stated: "No, they just made that up!" (translation from Swedish) about the animations in the tutorial.

One set-back was the obvious belief among the subjects that they were to be graded on their performance. This resulted in high estimations of how easy they believed the problem to be and how confident they were in their answers. An alternate interpretation is that since subjects worked in pairs, and tried to impress one another, they might very well have boosted the ratings regarding their confidence in being right and also rated the difficulty of the problems lower than was actually the case.

Another problem detected was a little halt in the pendulum movement when the animation came to an end and started over again. In cases were the animation was too short this little halt came about too often and disturbed the subjects' perception of the motion. When this halt came about just once in a while it did not seem to disturb the subjects that much, and was probably seen as a normal glitch in the computer. This interpretation of course presupposes that subjects had computer experience, i.e., they know that these things can happen.

4. Future Work

After a complete analysis of the pilot we plan to revise the software and perform a full-scale study comparing animation with still illustrations.

In revising the software we will reformulate questions that were unclear and in some cases ambiguous. An additional rating regarding the subjects experience from different computer programs (games, word-processing, edutainment etc.) will be added. Further, instructions given in the "test" part will be made more explicit since language problems in some cases made it difficult for the subjects to follow the instructions.

In the full-scale study subjects will interact with the test program one at a time. The interaction with the test program will be logged and results saved to a file. Subjects will also be encouraged to think aloud and be given an exercise in thinking aloud in the beginning of the test.

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Collaborative Instruction on the Web: Students Learning Together

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Introduction

The use of web-based instruction (WBI) is exploding in PK-12 and university programs (Rasmussen & Northrup, 1997). Many questions need to be addressed to allow educators to use this emerging technology effectively and efficiently. This study explores issues surrounding types of collaboration that can be facilitated among teachers and learners. This paper concludes with sample strategies for developing collaborative cohorts in distance education learning communitities.

Background of Study: Collaboration/Mentoring

In WBI teaching and learning processes, participants may be collaborators; traditional roles and relationships among instructors and students are altered. WBI requires participants to be visibly active in the learning environment. Students become equal partners with the instructor and collaborative efforts provide opportunities for mentoring novice technology and distance education users by matching novices with experts to help bridge initial WBI problems (Gray, 1997; Jennings & Dirksen, 1997).

Method

This case study explored how students and instructors collaborated in a graduate-level course, Trends and Issues in Instructional Technology which was delivered through the WWW. Class discussions were facilitated through electronic mail and informational material was available through the class home page. Online chat sessions were available to some learners. The research question for the study was: What type of collaborative relationships develop among learners and instructors in WBI? Design and development of the class was conducted by two instructors in graduate programs at two regional institutions. Course topics included: History of Instructional Technology/Instructional Design, Critical Issues, Instructional Design, Research, Evaluation, Technology, Business and Industry, Public Schools, and the Military.

The Setting

Classes at two regional universities participated in the study. Both courses were conducted during the Spring Terms in 1997; with one beginning in January on a semester schedule and the other beginning in April on a quarter schedule. The two courses overlapped during the month of April. Class 1 ended in April; class 2 ended in June, 1997. Instructor 1 had had prior experience in the design, development, and delivery of WBI. Instructor 2 had had prior experience in using the WWW, but had not facilitated WBI. Class 1 was comprised of

20 masters and doctoral students in an IT masters program or a Educational Management Doctoral program. Class 2 had 15 masters and doctoral students in an Instructional Design and Development program. Students had a wide variety of prior computer and telecommunications experience. Students at the two institutions did not know each other; many were acquainted with their own classmates. Instructors were unacquainted with students at the remote institution. The first week of each class was devoted to familiarizing students with class protocols. Intensive class work and discussions began during week two.

Data Collection

Data were collected from the following sources: student demographic information, online student discussion and assignments, online personality measurement, student interviews, student questionnaires, problems and solutions log, and online "observations" of all student and/or instructor interactions. Data was triangulated where possible, to limit potential bias and data anomalies.

Results/Discussion

All learners experienced anxiety at the onset of the class. Few had participated in a course at a distance and were unsure as to their role and responsibilities. However, students were excited to be participating in a class that was different from the norm that permitted them to work at their own schedules and convenience. Initial strategies to build class cohorts included sharing of personal biographies, personal course expectations, requiring minimum numbers of contact and comments, providing initial learning and web-searching strategies, and matching technology novices to experts for group projects. Students in Class 1 were comfortable with WBI by the fourth week of class, as evidenced by increased participation, in-depth responses, and non-related class e-mail "chatter." One student commented in week 4 that they could finally relax and enjoy the class. Results for Class 2 and the interaction between Class 1 and 2 followed a similar trend; however, comfort levels for Class 2 appeared to develop in fewer weeks, primarily due to a face-to-face initial meeting. In addition, students in Class 1 mentored students in Class 2, by answering their questions, providing strategies for distance learning, and working with Class 2 students in small groups.

Strategies for Developing Collaboration

Strategies used to facilitate development of a distance learning community included: group activities with changing membership each week, encouraging learner self-direction and exploration, forced numbers of responses, and modeling of teacher behavior through discussion leader assignments. Face-to-face meetings, when possible, also appeared to help learners develop relationships with one another and their instructor. Using a variety of strategies assists students in developing personal, teaching, and learning relationships with one another, adding to the complexity and significance of the learning environment.

Conclusion

Teaching and learning at a distance requires different strategies than traditional education. Instructors need to develop varied technological and design skills that facilitate learner success and performance. Strategies can be employed by both instructors and learners to facilitate transition to a web-based learning environment that results in meeting the needs of learners and instructors. These strategies provide a foundation that permit the successful use of WBI for varied learning environments, today and tomorrow.

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Knowledge Sharing over the World Wide Web

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Abstract: Large and increasing amounts of information are now available both on the Internet and on corporate intranets. With the availability of these vast networked information resources comes a requirement for tools to manage the information and provide users with the information they want, when they want it.

In this paper, we describe a system which facilitates and encourages the sharing of knowledge between groups of users within (or perhaps across) organizations. KSE (Knowledge Sharing Environment) is a system of information agents for organising, summarising and sharing knowledge from a number of sources, including the World Wide Web (WWW), an organization's internal intranet or from other users. Users are organized into closed user groups or *communities of interest* with related or overlapping interests. Such groups could be members of a project team, students studying the same subject (perhaps at different institutions), members of an organizational department, and so on. As well as sharing *explicit* (codified) knowledge, the sharing of *tacit* knowledge is encouraged via the automatic suggestion of and support for contact between people with mutual concerns or interests.

1. Introduction

There are now more than 60 million documents on World Wide Web (WWW) servers. Every day millions of people trawl the Internet for information using any one of a dozen or more different search tools. But whether they find what they're looking for sometimes depends not only on their skill, but also on their luck. Studies indicate that many existing search engines do not meet the needs of users [Pollock & Hockley 1996].

Recently, we have seen increasing interest in the use of Internet technology within organizations and the emergence of intranets [Cochrane 1997]. More and more information is being stored in intranet networks and this has led to the realization that these intranets are valuable repositories of corporate knowledge. Organizations are increasingly realising the importance of using knowledge and information residing in their networks for competitive advantage. It is forecast that annual spending on corporate intranets will top $2.1bn in the UK in 1998; for western Europe the total is expected to be over $7.7bn (Inteco Corporation 1997).

Key to the usefulness and viability of both the public Internet and corporate intranets, however, will be the ability to manage the information and provide users with the information they want, when they want it.

Of course, raw information in large quantities does not by itself solve business problems, produce value, or enhance competitiveness. Knowledge solves a problem. Knowledge is information transformed into a capability for effective action: that is to say, it produces competence leading to effective action. Thus today we see a great emphasis on the development of methods for turning information into knowledge. Information as a growing part of a company's asset base is often inefficiently captured, stored and sometimes simply lost. Knowledge management [Nonaka & Takeuchi 1995] is a strategy that turns an organization's information into greater productivity, new value, and increased competitiveness.

The first step in implementing a knowledge management solution is to provide seamless access to an organization's entire collection of information. Many organizations have begun this process through the provision of an intranet. The logical progression for organizations that have implemented intelligent information access software will be to extend it to deliver additional value to knowledge workers. Organizations need to look beyond their formal organizational structures to recognize communities of interest – informal networks of people with common interests who can share knowledge across departments, as well as perhaps continents and time zones.

In this paper, we describe a system which facilitates and encourages the sharing of information between communities of interest within (or perhaps across) organizations and which encourages people – who may not previously have known of each other's existence in a large organization – to make contact where there are mutual concerns or interests.

KSE (Knowledge Sharing Environment) is a system of information agents for organizing, summarizing and sharing knowledge from a number of sources, including the World Wide Web (WWW), an organization's internal intranet or from other users. Users are organized into user groups or *communities of interest* with related or overlapping interests. Such groups could be members of a project team, students studying the same subject (perhaps at different institutions), members of an organizational department, and so on. KSE extends and enhances our earlier work on the Jasper information agent, [Davies, Weeks & Revett 1995]. The Jasper agent automates the sharing of WWW-based information among a community of users with related interests. The additions and enhancements embodied in KSE, described below, are informed by the concerns of the knowledge management community and by the results of trials of the Jasper system.

2. Storing & Organising Knowledge in KSE

KSE agents are used to store, retrieve, summarize and inform other agents about information considered in some sense valuable by a KSE user. This information may be from a number of sources: it can be a note typed by the user him/herself; it can be an intra/Internet page; or it can be copied from another application on the user's computer.

Each KSE user has a personal agent which holds a user profile based on a set of key phrases which models that user's information needs and interests. As we will see below, KSE agents modify a user's profile based on their usage of the system, seeking to refine the profile to better model the user's interests.

Given the vast amount of information available on WWW, it is preferable to avoid the copying of information from its original location to a local server. Indeed, it could be argued that approach is contrary to the whole ethos of the web. Rather than copying information, therefore, KSE agents store only relevant meta-information. This meta-information is then used to index on the actual information when a retrieval request is made.

When a user finds information of sufficient interest to be stored by KSE, a 'store' request is sent to KSE via a menu option on his or her WWW client. KSE then invites the user to supply an annotation to be stored with the information. Typically, this might be the reason the information was stored and can be very useful for other users in deciding which information retrieved from the KSE store to access. The user can also specify at this point one of a predefined set of interest groups to which to post the information being stored.

In the case of WWW-based information the URL of the WWW page is then added to the KSE store. Similarly, when the user wishes to store some information from a source other than WWW, he or she can enter the information in a text box on their WWW browser and can again supply a relevant annotation. The information thus entered could be from a document in another format or might be a note or snippet of knowledge which the user wishes to enter directly themselves. This information is converted to a WWW HTML page on the user's KSE server and stored as before.

Essentially, the KSE store is a simple term-document matrix M, wherein:

$$M_{ij} = \begin{cases} 0 \text{ if term } j \text{ does not occur in document } i \\ n \text{ if term } j \text{ appears in document } i \text{ } n \text{ times} \end{cases}$$

At storage time, KSE agents perform four tasks:

(i) an abridgement of the information is created, to be held on the user's local KSE server. This summary is created using the ProSum text summarization tool. The summarizer extracts key theme sentences from the document. It is based on the frequency of words and phrases within a document, using the technique of lexical cohesion analysis [Davies & Weeks 1998]. Access to this locally held summary enables a user to quickly assess the content of a page from a local store before deciding whether to retrieve remote information.

(ii) the content of the page is analysed and matched against every user's profile in the community of interest. If the profile and document match strongly enough, KSE emails the user, informing him or her of the page which has been stored.

(iii) the information is also matched against the storer's own profile. If the profile does not match the information being stored, the agent will suggest phrases which the user may elect to add to their profile. Thus KSE agents have the capability to adaptively learn their user's interests by observing the user's behaviour.

(iv) for each document, an entry in the KSE store is made, holding keywords, an abridgement of the document, document title, user annotation, universal resource locator (URL), storer name and date of storage.

In this way, a shared and enhanced information resource is built up in the KSE store. Given that users must make a conscious decision to store information, the quality of the information in the KSE store is high - it is effectively pre-filtered by KSE users. Furthermore, each user leverages the assessment of the information made by all the other users.

3. Tacit & Explicit Knowledge in KSE

3.1 Sharing & Retrieving Explicit Knowledge in KSE

We have seen in the section above how KSE allows a user to store information of interest using an enhanced, shared bookmark concept. This facility goes well beyond the bookmarks familiar from WWW browsers such as Netscape Communicator, in that in addition to the reference to the remote WWW document, a summary of the document, an annotation, date of storage and the user who stored the information are recorded in a shared store. Furthermore, KSE can be used to store and organize information from many sources and in many formats (rather than only WWW-based information).

In this section, we discuss the various ways in which KSE facilitates access to and the automatic sharing of the knowledge thus stored.

Email notification

As described above, when information is stored by a KSE agent, the agent checks the profiles of other agents' users in its 'local community' (the set of users who contribute to that particular KSE store). If the information matches a user's profile with a score above a certain threshold, an email message is automatically generated by the agent and sent to the user concerned, informing the user of the discovery of the information. Thus in cases where a user's profile indicates that they would have a strong interest in the information stored, they are immediately and automatically emailed about the appearance of the information.

Keyword Retrieval – Accessing Information and People

From their KSE home page, a user can supply a query in the form of a set of key words and phrases in the way familiar from WWW search engines (see Fig. 1). The KSE agent then retrieves the most closely matching pages held in the KSE store, using a vector space matching and scoring algorithm [Salton 1989] as follows:

$$sim(q,d) = \Sigma_{i=1,n} (t_{iq} * t_{id}) / \sqrt{[\Sigma_{i=1,n} t_{iq}^2 * \Sigma_{i=1,n} t_{id}^2]}$$

where t_{iq} is the i^{th} term in the query q
and t_{id} is is the i^{th} term in the document d
and n is the number of unique terms in the combined profiles of user u_1 and user u_2.

In addition to these pages from the KSE store, the agent can also retrieves a set of pages from an organization's intranet and from the WWW. The agent then dynamically constructs an HTML page with a ranked list of links to the pages retrieved and their abridgements, along with the scores of each retrieved page. In the case of pages from the KSE store, any annotation made by the original user is also shown. Note that the user can ask their agent to search for other users by selecting the appropriate check box (see [Fig. 1]). We will have more to say about this capability to identify other *users* as well as *information* in section 3.3 when we look at accessing explicit and tacit knowledge using KSE.

What's New

A user can ask his KSE agent "What's new?" The agent then interrogates the KSE store and retrieves the most recently stored information. It determines which of these pages best match the user's profile. A WWW page is then presented to the user showing a list of links to the recently stored information, along with annotations where provided, date of storage, the storer and an indication of how well the information matches the user's profile.

In addition, a series of buttons are provided so that the user can:

(i) add their own comment or annotation to information stored by another user;
(ii) indicate interest or disinterest in a particular piece of information – this feedback will be used to modify the user's profile;
(iii) examine a locally held summary of the information before deciding to download all the information;
(iv) ask their KSE agent to identify other users with an interest in the information under consideration (see section 3.2).

This What's New information is in fact displayed on the user's KSE home page, so that whenever they access the system, they are shown the latest information. A typical KSE home page is shown in [Fig. 1].

Figure 1: A Typical KSE Home Page

Interest Groups

As mentioned above, when a user stores information in KSE, he has an opportunity to specify one of a predefined set of interest groups to which to post the information. Interest groups gather together pages of related information. KSE users can visit interest group pages which are dynamically constructed from the pages which have been posted to them and consist of a list of links to the pages and their abridgements, along with any annotation provided by the original storer of the page. Interest groups are similar to the 'list of links' pages found in many WWW locations, with the important extensions that multiple users can contribute to the list (automatically via the storage process) and that abridgements of the information and annotations by the original storer of the link are also available.

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3.2 Adaptive Agents

We have already mentioned that KSE agents adapt to better understand their user's interests over time. There are two types of event which trigger the profile adaptation process.

As discussed above, when a user is storing some information, if the profile does not match the information being stored KSE will extract the main themes from the information using a unique theme extraction algorithm [Davies, Weeks & Crabtree 1998]. The user's agent then suggests to the user new phrases they may wish to add to their profile. The user can accept or decline these suggestions.

Similarly, when information stored by another member of the community is retrieved by a user using one of the methods described in section 3.1, a feedback mechanism is provided whereby the user can indicate interest or disinterest in the information by clicking on a button (indicated by ☺ or ⊗ as shown in Fig. 1). Again, the agent will suggest to the user phrases which should be added to or removed from the profile.

3.3 Finding People & Tacit Knowledge in KSE

In the section 3.1, we focused on the *technical* aspects of KSE and on explicit knowledge. We now turn to the *social* aspects of the system and tacit knowledge.

A large amount of the knowledge within an organization may of course not be codified: it may be personal, context-specific and difficult to write down. Such knowledge is referred to as *tacit* knowledge [Polyani 1966]. When tacit knowledge is difficult to make explicit (codify), we need to find new ways of transmitting the knowledge through the organization. Failure to do so can lead to loss of expertise when people leave, failure to benefit from the experience of others, needless duplication of a learning process, and so on.

One way in which a system such as KSE can encourage the sharing of tacit knowledge is by using its knowledge of the users within a community of interest to put people who would benefit from sharing their (tacit) knowledge in touch with one another automatically.

User profiles can be used by the KSE system to enable people to find other users with similar interests. The user can request KSE via their WWW client to show them a list of people with similar interests to themselves. KSE then compares their profile with that of every user in the store and returns to the WWW client for viewing by the user a list of names of users whose interests closely match their own. Each name is represented as a hypertext link which when clicked initiates an email message to the named user. Profiles in KSE are a set of phrases and the vector space model can be used to measure the similarity between two users u_1 and u_2:

$$sim(u_1,u_2) = \Sigma_{i=1,n} (t_{i1} * t_{i2}) / \sqrt{[\Sigma_{i=1,n} t_{i1}^2 * \Sigma_{i=1,n} t_{i2}^2]}$$

where t_{ij} is the i^{th} term in the profile for user u_j
and n is the number of unique terms in the combined profiles of user u_1 and user u_2.

A threshold can then be used to determine which users are of sufficient similarity to be deemed to 'match'.

This notion is also extended to allow a user to view a set of users who are interested in a given document. When KSE presents a document to the user via their WWW client using the "What's new?" facility (see above), there is also a hyperlink presented which when clicked will initiate a process in the KSE system to match users against the document in question, again using the vector cosine model. KSE determines which members of the community match the relevant document above a predetermined threshold figure and presents back to the user via their WWW client a list of user names. As before, these names are presented as hypertext links, allowing the user to initiate an email message to any or all of the users who match the document.

In addition, as we have already discussed in section 3.1, a user can carry out a keyword search on other users and thus identify users with an interest in a particular subject.

In this way, KSE, while not claiming to actually capture tacit knowledge, provides an environment which actively encourages the sharing of tacit knowledge, perhaps by people who previously would not otherwise have been aware of each other's existence.

4. Conclusions

We have described KSE, a tool for encouraging the exchange of tacit and explicit knowledge amongst a community of interest. KSE builds on our earlier work with the Jasper system and incorporates a series of extensions including:

- the ability to store information from multiple sources (rather than simply WWW pages);
- the facility for multiple users to annotate information;
- the ability to search for other *users* (as well as *information*) in a variety of ways;
- the facility for users to provide feedback on retrieved information in order to modify their profile.

[Fig. 2] shows the main features of the KSE system of agents, people and information: users can create, store and organize information; they can locate relevant information stored by others in their community of interest and they can contact other users with overlapping interests.

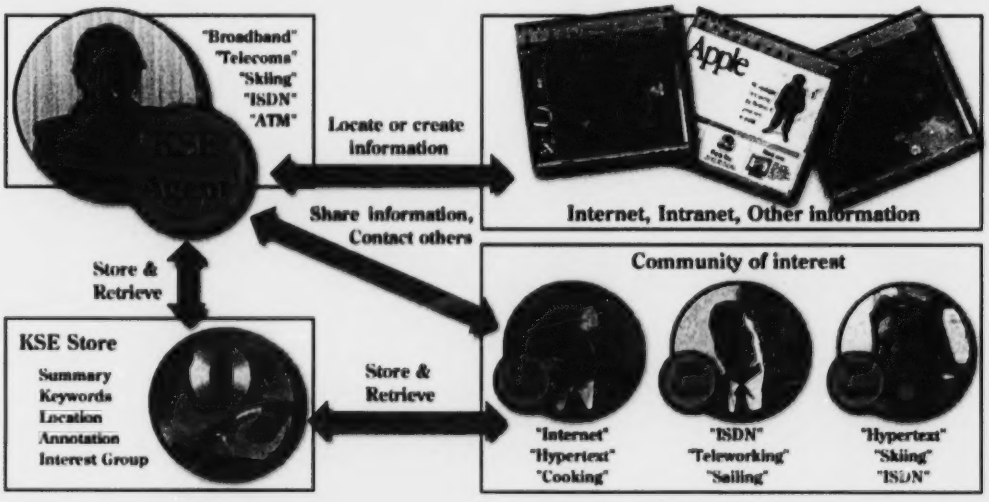

Figure 2: The KSE

In his seminal article, Bush [Bush 1945] describes a tool to aid the human mind in dealing with information. He states that previous scientific advances have helped humans in their interactions with the physical world but have not assisted humans in dealing with large amounts of knowledge and information. Bush proposed a tool called a 'memex' which could augment human memory through associative memory, where related pieces of information are linked. Trails through these links could then be stored and shared by others. WWW itself fulfils Bush's vision in some respects: Bush's associative memory can be seen in the hyperlinks of WWW. What is lacking is a way of organising this vast 'memory' of WWW pages into coherent 'trails' which can be saved and communicated to others. Currently, only relatively simplistic bookmarks and menus are available.

KSE goes some way to addressing these problems by providing agents which, as we have seen, can store meta-information about WWW pages which can then be used to retrieve relevant pages quickly and easily and share the information contained in those pages with other users with the same interests. In addition, KSE can put users

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in touch with other users who share their interests in general or who share their interest in a specific document. In this respect, KSE is moving into the area of tacit knowledge in the sense that it is suggesting useful person-to-person interactions wherein tacit knowledge can be exchanged. So as well as addressing the issue of how best to search WWW for information, KSE is an attempt to address the complementary problem of how best to store information once it has been found and how to share information with others with the same interests. KSE is a step along the road towards the original vision for WWW [Berners-Lee 1991] as a network which supports fully co-operative working and the sharing of knowledge.

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Documentation Multi-Targeting Using ASML & JavaScript

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Abstract: We have developed a document system that enables multiple format versions of the same document on the WWW, as well as a user-friendly interface for non-linear navigation of the formatted document. We have efficiently applied the system to provide LaTeX documents on the WWW. In addition, we have developed a hyperlink network that allows efficient presentation and non-linear navigation of LaTeX content incorporating JavaScript. This type of multi-targeting is quite significant for allowing posting of a document on the WWW in different formats, so that multiple users can navigate into formats they individually understand. A printable version of the document is also obtained by converting the LaTeX file to a PostScript one. Hence, we obtain two versions, one optimized for display and one for printing, by editing a single original document. The documentation medium that allowed us to implement this multi-targeting is the Automatic Site Markup Language (ASML) developed in the DEVLAB [DEVLAB 98].

Introduction

Document *multi-targeting* is the ability to author, present, and maintain closely related document content in multiple formats with minimum manual effort. This ability is useful in many applications where content may be altered or refined and needs to be used or adapted for different conditions or users. In this paper, an extension of the Automatic Site Markup Language (ASML) site level authoring system for the World Wide Web [Owen et al. 97, Owen 98], is described and is shown to be useful for multi-targeting content for the World Wide Web. Multi-targeted documents should have the following features: (1) permit easy-to-make changes with centralized facilities; (2) minimize the duplication effort; (3) enable document production without knowledge of scripting languages and (4) avoid custom programming need. ASML provides a tool for this process.

LaTeX is a widely available, sophisticated, and powerful document generation language used extensively in many academic environments [Lamport 86]. By implementing ASML templates, we have designed a system that allows user-friendly editing of LaTeX documents on the WWW that permits viewing LaTeX content as a hierarchical structure of hyperlinks. This allows users to post their LaTeX documents on the Web so that others can derive and save their own updated versions, while leaving the original document intact. Further, establishing a hyperlink network for LaTeX content allows efficient non-linear navigation of the LaTeX content. This navigation has been implemented in JavaScript.

Once LaTeX documents have been downloaded through the system, users can obtain printed versions by converting them into PostScript. Thus, the system presents a Web-based displayable form of a document while preserving a version designed for printing. The operational flow of the system is illustrated in Figure 1.

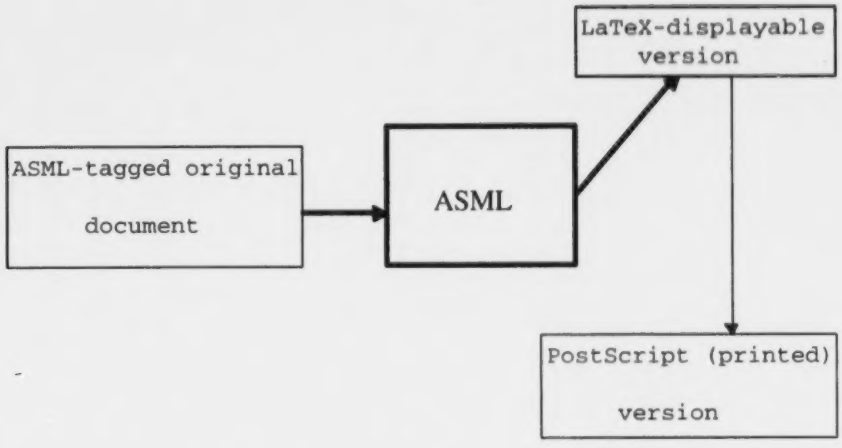

Figure 1: Operational flow of obtaining a displayable and a printer version of a document

Related Work

The usual approach to multi-targeting is to author in one distribution environment, then convert to the other formats. ASML can be compared to HTML conversion utilities (though it has many more features). An example is authoring in LaTeX, then converting the LaTeX to HTML using the LaTeX2HTML tool [Drakos 94]. Such tools are primarily designed to facilitate conversion of existing content. Because the mechanics of the target format (such as HTML) are not available in the alien environment (as they are in ASML), conversion tools limit the designer's flexibility. Converters exist for a wide variety of environments include most commercial word processors and page layout programs. All of the above mentioned conversion approaches lack the ability of editing an original document once, whose further compilation displays the file on the WWW in different formats.

Object Oriented Modeling of LaTeX documents

In Figure 2, we illustrate a representative physical structure of a LaTeX document.

```
\begin{document}
\title{A LaTeX document}
\begin{abstract}
.............................
\end{abstract}
\chapter{Introduction}
A sample introduction for a LaTeX document
\section{Section 1}
.........................
\subsection{A subsection}
.........................
\begin{center}              \leavevmode{\psfig{figure=fig1.eps,
height=3in}}
.........................
\end{document}
```

Figure 2: A sample of the physical structure of a LaTeX document.

In the logical structure hierarchy of a LaTeX document, called an *article*, a LaTeX document is composed of child components. For instance, we have a title, an abstract, and chapters with sections as children, each of which themselves have subsections as children, and which can further have figures as children. Hence, one can realize a *hierarchical container relationship* of the entire article. We further consider that a LaTeX document provides the following *content class types:* Title, Abstract, Chapter, Section, Subsection, Math, Figure.
This implies the following logical structure hierarchy of an article, as it appears in Figure 3.

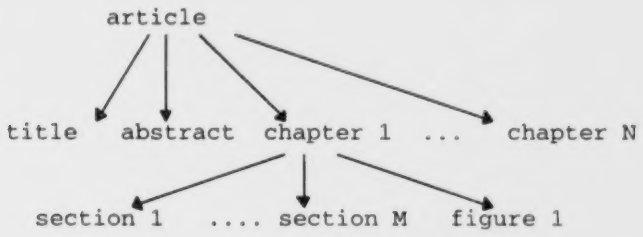

Figure 3: Logical structure hierarchy of a LaTeX document.

We further consider each content class to be derived from a virtual *HTML page class*, which further allows the user of the system to present any content of the article through non-linear navigation.

Implementation of a Web-based LaTeX Presentation System

Exploiting the power of ASML templates allowed us to develop a component-based system for editing LaTeX document on the WWW that uses the logical hierarchy of Figure 3. It represents this structure by constructing a network of hyperlinks.

The system is composed of the following components, called *packages* :

- **Macros** Package: Defines LaTeX environments, commands, TeX definitions.
- **ControlDocument** package: Defines grouping of textual LaTeX content objects (e.g., chapters, sections, etc.)
- **DocumentConfig** package: Defines boxes, fonts, page size width, as well as, any kind of information relevant to the appearance of the article.

This system architecture allows the user to include only the packages necessary to the composition of an article. In Figure 4 we give a sample of ASML templates from the ControlDocument package.

```
{-------------------------------------------------}
{--         The Control Document Package          --}
{-------------------------------------------------}
{define name="title"}
    \{\\huge\\bf\{{tName}\}\} \\\\ <br>
     <a name="{start}"></a><br>
{/define}

{define name="subtitle"}
    \{\\LARGE\\bf\{{stName}\}\} \\\\ <br>
{/define}

{define name="subsubtitle"}
    \{\\Large\\bf\{{sstName}\}\} \\\\ <br>
{/define}

{-- we assume numbered chapters  --}
```

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```
{define name="chapter"}
    <pre></pre>
     \\chapter\{{aTitle}\}<br>
    <a name="chap{chapNum}"></a><br>
    <pre></pre>
{/define}

{-- Sections -}
{define name="nSection"}
    <pre>
    </pre>
    \\section\{{nSecName}\}<br>
    <a name="sec{cNum}_{sNum}"></a><br>
    <pre></pre>
{/define}
```

Figure 4: A sample of the ASML ControlDocument package for LaTeX document

The network of hyperlinks is implemented by the writing of anchor names with proper syntax; e.g., for a section there is an anchor name of the form `sec{cNum}_{sNum}`. This is an exact realization of the logical structure hierarchy presented in Figure 3. This hierarchy is shown again with only the hyperlink communication between parent-children in Figure 5.

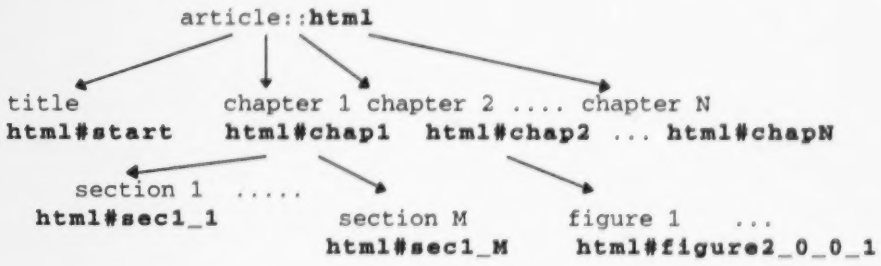

Figure 5: A hyperlink network on the logical content hierarchy.

Example Site

A prototype Web site created using this templated system is shown in Figure 6 [Sasles 98]. A Web-based graphical-user interface facilitates the presentation of the multiple-format document. The example source document chosen was a section of the documentation of ASML. The GUI presents the source document in a window, supplemented by a browsing access utility displayed constantly in a separate frame. This utility includes incremental chapter and section buttons for chapter-by-chapter browsing, as well as a jumping mechanism to access any given chapter and section non-linearly. The crucial part of this system's multi-targeting nature is its ability to switch between formats easily. A dropdown list is used to offer the user the choice between viewing HTML or LaTeX formats, as well as the option of split-screen viewing, where the document is displayed and navigated synchronously in both formats.

Also included is a figure-browsing utility that allows the user to skip to each figure incrementally throughout the document (See Figure 7). Using this utility, the user may browse through the selected material in HTML or in LaTeX, switching between the two formats as he or she chooses and saving whichever format is desired, according to his or her needs. A user might browse the HTML version until she finds what she is looking for, then access some other part of the file to satisfy her own needs, e.g., saving in some specific format or printing.

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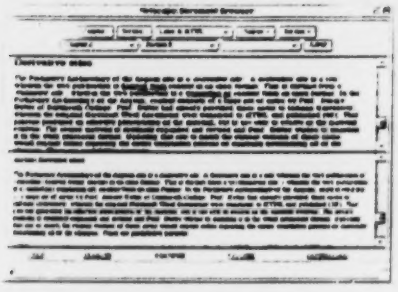

Figure 6: A dropdown list is used to offer the user the choice between viewing HTML or LaTeX formats, as well as the option of split-screen viewing

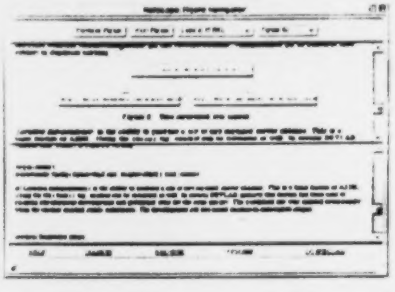

Figure 7: figure-browsing utility that allows the user to skip to each figure incrementally throughout the document

The GUI for this project was implemented using JavaScript. JavaScript is widely accepted (a crucial aspect of making this system accessible was using "lowest-common denominator" tools) and allows fully functional frame-based Web browsing, an accepted modern standard on the World Wide Web.

Conclusion and Future Work

We have described the prototype of a system that allows display and non-linear navigation of a LaTeX document accompanied by its HTML version. In addition, we described the steps of obtaining a PostScript version of the original document for printing. A future enhancement of this approach is to manually or automatically add links to the HTML version to improve navigation within that version, and in the process, facilitate navigation for all associated formats.

A very powerful enhancement would be the support of built--in tags that perform C++ function calls; since ASML has been developed in C++, this would permit use of C++ programs in Web site development. This could enable ASML as a alternative to HTML with Java applets. Additionally, such a feature would allow users develop their own content retrieval systems that could, for example, selectively cluster existing content of a document, from which he/she could compose a new one. In other words, ASML could become the computational intermediate system for melding multi-targeting and document content retrieval.

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Adaptive Hypermedia on the Web: Methods, Technology and Applications

(invited talk)

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Abstract: World Wide Web lets information providers (potentially) reach millions of people located all over the world. These users form a very diverse crowd. No single presentation of the information an organization wishes to distribute will be suitable for all types of users that organization wishes to address. Adaptive hypermedia techniques make it possible to provide each individual user with the information and presentation he or she needs, based on an internal representation of that user, called the *user model*. The user's goals, preferences and needs may change over time. An adaptive Web-site observes these changes, updates the user model on the fly and uses it to adapt the presentation to the changing circumstances.

This paper gives a very brief overview of some existing adaptive hypermedia methods and techniques. Both the (textual or multimedia) content of pages and the links between them can be adapted. The paper indicates which Web technologies are (sometimes or typically) used to realize adaptive Web sites. This includes both technical hacks to make it work and authoring tools intended for subject-matter experts who are not (necessarily) very computer or hypermedia savvy.

Through examples of applications we show reasons for making a Web site adaptive in certain ways. Adaptivity must be used with caution in order to avoid Escher effects that might turn browsing through an adaptive Web site into an adventure game instead of making it easier and more effective.

keywords: adaptive hypermedia, adaptive Web sites, user modeling, adaptive presentation, adaptive navigation, adaptive authoring tools.

1. Introduction

World Wide Web is a great medium for potentially reaching millions of people located all over the world. This potential has been exploited by thousands of companies, research organizations and educational institutes. Web sites have been created for informing customers and business partners, research colleagues, students, visitors and many other categories of users. More and more Web site builders are beginning to realize that one uniform Web site cannot offer the information these millions of different users need, and certainly not offer it in a way that is best suited for each individual user. This is where adaptive hypermedia comes into play. Using an internal representation of a user, called the *user model*, a hypermedia system or Web server can change the information and its presentation according to a user's individual goals, preferences and/or needs.

Adaptive hypermedia (or AH for short) is a research and development field which has its roots in the crossroad of hypermedia and intelligent tutoring systems. As a result, a majority of adaptive hypermedia systems (or AHS), beit Web-based or not, are used for educational applications, and especially for interactive course texts that allow access to more advanced learning material as the student gains knowledge. However, as the Web is

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being used more and more by companies for promoting and providing information about their products and services, the need arises for providing each individual user with the most appropriate information, in the most desirable form. For instance, browsing through a paper mail-order catalog can be done much faster and more effectively than browsing through an electronic version of that catalog. However, most of the catalog is of no interest to a particular user, and it is time consuming to find the appropriate offerings among the wealth of irrelevant stuff that is also for sale. When an electronic catalog knows what the user's interests are, and possibly what goal the user has during a specific browsing session, it can present the appropriate information very efficiently, thus saving the user some valuable time, and not distracting the user in a way that may lead to no purchase at all. Companies have been formed, and more are coming, that specialize in gathering a lot of information about an individual user, so that this rich user model can be used for adaptive access to Web sites. In this paper we concentrate on techniques that are used for creating adaptive Web sites. We ignore the obvious social and legal privacy issues that arise when user models are exchanged between Web sites (of different companies) or requested by authorities for tracking an individual's Internet activities.

The Web was not designed with adaptive hypermedia in mind. As a result, the standards defined for Web technology, including HTML and HTTP, sometimes hinder the creation of adaptive documents. In the future, dynamic HTML (or DHTML for short) may offer a solution to the need for alternative presentations of content. Since DHTML involves a combination of "pure" HTML, Style Sheets (using CSS) and Javascript or VBscript code we will need sophisticated authoring tools for generating DHTML automatically, as it is impossible for non computer scientists to write DHTML documents manually. HTTP is also lacking some feature(s) that are needed to make adaptive presentation work under all circumstances. We will describe possible ways to program around the Web's shortcomings in order to realize adaptive Web applications.

This paper is structured as follows: Section 2 [Classification] gives a classification of adaptive hypermedia techniques. Section 3 [User Modeling] describes how systems may store information about users in order to do adaptation. It also relates this representation to the issue of authoring. Section 4 [Implementation] shows how adaptivity can be achieved on the Web.

2. Classification of adaptive hypermedia methods and techniques

Adaptive hypermedia (AH) is a term used in different meanings throughout the hypermedia literature. To avoid any confusion we distinguish:

- **Adaptable hypermedia systems** allow the user to explicitly set preferences, or provide a profile through filling out a form. This information is stored in a *user model*. The presentation of the information is then adapted to that model, which is only updated upon explicit request by the user. Some systems may have very elaborate user models, while others only distinguish between a few stereotype users such as "beginner", "intermediate" and "expert",or "student", "employee" and "visitor".
- **Adaptive hypermedia systems (AHS)** build a *user model* by observing the user's navigation through the information space, and in educational systems also by means of (mostly multiple-choice) tests. The presentation is adapted to the user model, and the user model is constantly updated as the user reads the information.

Most AHS are also adaptable, because they need a way to initialize the user model, or to allow users to explicitly adjust that model. However, we shall concentrate on the adaptive features of the systems and applications.

In his overview article Brusilovsky [Brusilovsky 96] describes which AH techniques exist. We briefly recall this classification and refine it as was previously done in [De Bra & Calvi 98]. We also indicate sample applications or application areas where such techniques are (potentially) useful.

Adaptive presentation is the general term for all techniques that adapt the content of a Web page according to the user model. Brusilovsky [Brusilovsky 96] distinguishes:

- **Adaptive text presentation:** the textual content of Web pages is altered depending on the user model. Technical terms can be avoided for beginners, and additional explanations added. Likewise, additional details can be provided for advanced users who are capable of understanding them. Three techniques for creating adaptive text presentation are:
  - *page variants*: several (or a few) different versions exist for a given page. This technique fits a stereotype-based AH system, in which the variation is limited.
  - *fragment variants*: different versions of fragments of a page exist. Fragments can be as small as a single word (like a technical term which can be replaced by a common term which means almost the same), and as large as a whole page. (Thus, page variants are a special case of fragment variants.) The number of variations of a page can be large since each fragment can be adapted to different variables in the user model.
  - *frame based techniques*: using natural language techniques pages are assembled from small information items like words and parts of sentences.
- **Adaptive multimedia presentation:** although this term suggests that multimedia content elements might be adapted to the individual user, current implementations are limited to media selection. Unlike with text, the content of an animation, audio or video fragment is not adapted.

Adaptive navigation is the term for techniques that manipulate the links that are available to the user (at any given moment in time). Brusilovsky [Brusilovsky 96] and De Bra and Calvi [De Bra & Calvi 98] distinguish:

- **Direct guidance:** a link is provided to whichever page the system considers to be most appropriate for this user to go to next. The repeated use of such a "next" button is like following a personalized guided tour.
- **Adaptive sorting of links:** instead of providing a single "best" link this technique provides a list of links, in descending order of relevance. Information retrieval (searching) systems typically provide this kind of list of links. But in educational AHS an adaptively sorted list of links can also be provided to provide guidance as to which pages to read to learn about a certain concept. In [Weber & Specht 97] adaptive "curriculum sequencing" was found to reduce the number of navigation steps a user needs to learn a concept.
- **Adaptive link hiding:** in order to avoid an abundance of links the AHS hides links to currently non-relevant information by making the link anchor (the text which is normally underlined and/or displayed in a different color) indistinguishable from normal text.
- **Adaptive link removal:** this technique removes the link anchor for non-relevant links. This can only be done when the surrounding text still makes sense after removing the link. In a list of items one can easily remove items. In [Brusilovsky & Pesin 95] experiments with ISIS-Tutor are described, where links to non-relevant items were removed. While adaptive link removal is effective in reducing the number of navigation steps, preliminary evaluations [Calvi & De Bra 97] show that users dislike this technique.
- **Adaptive link disabling:** the link functionality is removed but the link text remains. This technique is often combined with link hiding, because if the appearance of an anchor remains, but the link does not "work" the user may think there is a system error. Users dislike adaptive link disabling [Calvi & De Bra 97] but still prefer it over adaptive link removal.
- **Adaptive link annotation:** links are annotated to indicate their relevance. This can be done by changing the presentation (e.g. color) of the anchor itself or by providing another visual cue like a colored dot or arrow. Several systems developed by Brusilovsky, together with others, use adaptive link annotation, combined with other techniques. These systems include ISIS-Tutor [Brusilovsky & Pesin 94], ELM-ART [Brusilovsky et al. 96a] and Interbook [Brusilovsky et al. 96b]. Experiments (see e.g. [Eklund & Brusilovsky 98]) have lead to the conclusion that adaptive link annotation is helpful in reducing the number of navigation steps and in improving comprehension of the learning material.
- **Map adaptation:** a few hypertext systems provide graphical overviews of the link structure of a hyperdocument. This map can be adaptively filtered to present a manageable overview of the parts of the hyperdocument that are relevant to the user.

In [Calvi 98] there is a discussion about the benefits and drawbacks of some of these adaptive linking techniques. Experiments and preliminary evaluations (see e.g. [Eklund & Brusilovsky 98] and [Calvi & De Bra 97]) lead to inconclusive advice: the goal to increase user satisfaction can be served through adaptive link annotation, whereas for improving the efficiency of navigation link removal and/or disabling work better.

3. User Modeling in AH

AHS need an internal representation (or approximation) of the user's state of mind in order to adapt the presentation and navigation to that user. The AHS needs to know the user's goals and task, background, experience in the subject matter, experience in hypermedia navigation, preferences like media, verbosity, etc. Some of this information, namely preferences and sometimes also goals and task AHS from the user's browsing behavior.

Information about the user's state of mind is typically implemented through an *overlay model*. The user's state is compared to a set of variables. Because of the focus of the field of AH on educational systems these variables are often called *concepts*. We shall also use this terminology, but keep in mind that these variables can have any meaning and use, other than representing the user's knowledge about a certain concept.

We distinguish three (sub)types of knowledge representation, differing in the data type used for the concepts:

- In the **Boolean** model there are two possible values for each concepts: *true* and *false*, which could be interpreted as *known* and *not known*. However, the values may actually mean something completely different, like *verbose* and *terse* to indicate whether a user wants a lengthy or short version of each page. Some AH courseware developed by this author uses the Boolean model.
- In the **discrete** model there are a small number of values for each concept. (The Boolean model is a special case of the discrete model.) Systems like ELM-ART [Brusilovsky et al. 96a] and Interbook [Brusilovsky et al. 96b] use a discrete model with four values, meaning *not known*, *learned*, *well learned*, and *known*. A concept becomes *learned* when the user has read about it while she was not ready for it; it becomes *well learned* when the user has read about it while she was ready for it, and it becomes *known* when the user has passed a test about the concept.
- In the **continuous** model there is a range of values, e.g. the real numbers between 0 and 1. Values can be interpreted as *how much* a user knows about a concept, or alternatively as *the chance that* the user knows a concept. The model used by Pilar da Silva [Pilar da Silva 98] comes close to being a continuous model. Instead of values between 0 and 1 it uses percentages (between 0 and 100), thus providing many more possible values per concept than any other discrete model.

It will be clear that the possibilities for adapting a hyperdocument to each individual user are greater in the continuous model than in the discrete model or the Boolean model. However, in order to exploit these possibilities the author (and authoring software) must be able to deal with such a rich value set. In hyperdocuments authored for the Boolean model there is typically a one-to-one relationship between concepts and Web-pages. The user learns about a concept by reading a (single) page. The discrete model may relax this constraint a little bit, for instance by associating a Web page and a test with a single concept. Both techniques lead to a *fine grained* user model, with many detailed concepts. In the continuous model it is possible to associate may pages with a single concept. Each page contributes towards the knowledge of that concept. The concepts may be *coarse grained*, meaning that they represent fairly global knowledge items. This makes it easier to export the knowledge from one AHS to another, assuming that other AHS may not be able to interpret the detailed distribution of knowledge over a large set of (small) concepts.

Authoring AH documents requires that the writer first construct a global map of how he wants the knowledge to be presented to the user. This means determining which concepts will make up the user model, and how these concepts depend on each other or maybe contribute towards knowledge about each other. While it may help the author a bit when the system provides a (graphical) tool for editing this concept map, the main benefit of such a tool is that it helps the system in automating the dependencies. In order to use the concept map each concept must be tied to the pages dealing with that concept. To some extent this could be done automatically through word frequency techniques used in information retrieval, see e.g. [Golovchinsky 97]. However, it will be mostly the author who gets to decide how pages relate to concepts. Determining exactly what the contribution of a single Web-page is to a concept for which there are many pages is difficult.

4. Implementing AH on the Web

In order to provide AH on the Web the server needs to be able to generate Web-pages (in HTML) that are adapted to each individual user. This is typically achieved through a server-side scripting technique such as *servlets* or *CGI-scripts*. In the sequel we call the Web-server plus its scripts the AH engine. The source for the pages, as written by the author, need not necessarily be HTML. The AH engine can translate different source formats to HTML on the fly. This is especially useful for authors who are not used to writing HTML documents. However, the difficulties in creating adaptive hyperdocuments are the same regardless the source language:

- Most Web-pages contain links to other pages. The author must indicate which links are subject to adaptation and which are not. The AH engine manipulates the adaptive links using one of the techniques from [Classification]. In Interbook [Brusilovsky et al. 96b] for instance adaptive links are annotated by means of a colored ball or arrow (which follows the link anchor), while in AHA [De Bra & Calvi 97], [De Bra & Calvi 98] the link anchor text is displayed in blue, purple or black depending on the relevance of the link. (The link is thus annotated or hidden depending on the situation.)
- Some systems provide additional guidance through an annotated table of contents or a textual or graphical representation of (part of) the user model. Such information is often generated automatically, but the author needs to be aware of what information will be displayed. An author who knows this generated information can avoid to repeat it unnecessarily in the information pages.
- The content of the authored Web-pages may need to be adaptive as well. Technical terms should be avoided for users who have not studied their definition. Additional details may be provided for users who have enough experience in the topic at hand. Variations can be achieved by using the *fragment variants technique*, described in [Classification]. This technique requires that the authoring environment provides a facility for indicating which variation of each fragment is displayed, depending on which condition on the variables in the user model.

Currently, tools for authoring adaptive text presentations in an easy way are still lacking. AHA [De Bra & Calvi 97], [De Bra & Calvi 98] for instance uses "*if statements*" encoded as HTML-comments. This technique is convenient for authors who are familiar with authoring HTML and with logic. The majority of authors of Web-pages will most likely not be able to use such an authoring environment.

Implementing an AH engine is also non-trivial. In an AHS it is common that when the user revisits a page the appearance of that page may (need to be) different. Links may be sorted or annotated differently, text fragments may have changed, a "next" button may point to a different location, etc. While the changes are usually subtle, in order to avoid Escher effects, the architecture of the Web makes it difficult to offer even small variations to pages: the HTTP standard (version 1.1) states:

> *By default, the Expires field does not apply to history mechanisms. If the entity is still in storage, a history mechanism should display it even if the entity has expired, unless the user has specifically configured the agent to refresh expired history documents.*
> (quoted from RFC's 1945 and 2068, which define HTTP/1.0 resp. 1.1)

Unfortunately, the "agent" (meaning the Web-browser) is not required to offer the option of refreshing expired documents when going back to them. Luckily the two most popular browsers (Netscape Navigator and Microsoft Internet Explorer) do request expired documents from the server each time they are revisited. (However, due to a bug in Netscape Navigator, it may be necessary to disable the browser's memory and disk cache when going through a proxy gateway. This adversely effects the overall server load and browser performance.) Older browsers, including NCSA Mosaic for X (the browser that made the Web popular, long before Netscape Navigator and Internet Explorer existed) may refuse to revisit pages that are available through the browser's history mechanism.

When a Web-based AHS uses HTML frames (a presentation technique introduced by Netscape and later incorporated in the HTML 4.0 standard), following a link within one frame may result in the other frames no longer corresponding to the actual user model. In order to update the other frames, a small piece of Javascript or VBscript code must be added to each page, requesting the other frames to be updated if needed. The two most popular browsers support Javascript, but some others may not.

Adaptive link annotation, and link hiding, can be done by changing the color of the link text. This requires the use of HTML style sheets, a technique introduced with the HTML 3.2 standard. Again, not yet all browsers support style sheets.

5. Conclusions and final remarks

There exist many different techniques for adapting the presentation of information and the navigation between pages on the Web. Several applications have been evaluated and show the benefits of the different adaptive hypermedia techniques. However, there is no evidence that the findings of these experiments can be generalized to all applications that use these techniques. In fact, the process of constructing a user model, determining dependencies between concepts, and tying concepts to Web-pages is not yet automated. While adaptive hyperdocuments *can* be created that are easier to use than static equivalents, the techniques can equally well be used to make navigation through a hyperdocument more difficult. There currently exist no (software) tools for verifying the usability of adaptive hyperdocuments. Therefore, user evaluation remains the most important way to determine the effectiveness of adaptivity for a particular application.

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Using adaptive hypermedia for Web-based education

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Adaptive hypermedia (AH) techniques are used to adapt Web-sites to each individual user (or user group) in order to provide (links to) the most relevant information for that user. The tutorial "Adaptive Hypermedia and its Implementation on the World Wide Web" provides valuable (but not strictly necessary) knowledge for attendees of this tutorial. It explains all different methods and techniques used in AH systems. During this tutorial we will demonstrate the creation of adaptive Web sites using two different AH systems:

- An adaptive hypermedia engine "AHA" was developed at the Eindhoven University of Technology, by Paul De Bra. Adaptive hyperdocuments in this system consist of (standard) HTML pages. Authoring the pages for AHA-hyperdocuments is easy. AHA can be used with any standard Web server. It consists of CGI- or FCGI-scripts written in Java. The presentation can (and must) be determined entirely by the author. This includes the choice of an optional frames structure and the (JavaScript) code to keep frames synchronized. A choice of link colors determines whether adaptive link hiding or adaptive link annotation is used. During the tutorial AHA will be used on a PC with Windows'95, but AHA can be used in the same way on Unix workstations.
- Interbook was developed by Peter Brusilovsky. It provides tools for generating guided tours for users who have a specific goal, as well as adaptive navigation for users who with to explore the whole adaptive hyperdocument. Interbook uses a frames presentation structure which is kept synchronized by the system itself. It provides information on the concepts a user has learnt and concepts still to learn to achieve a given goal. Interbook uses a Lisp-based Web server and software. During the tutorial an adaptive Interbook document will be developed on a Macintosh.

Attendees of this tutorial should have some experience with creating (static) Web pages. They will learn how to create adaptive Web pages in general, and get a demonstration of authoring for AHA and Interbook.

The (first) presenter:

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A Corporate Application to the Process of Environmental Management

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Abstract: This paper's purpose is to present a functional description of a groupware-type application that controls the environmental management process [Michelis] [Dix 1996]. The application, named SIGMA, was developed for PETROBRAS and has three main objectives: to provide the users information on the process of environmental licensing: to help users conduct this work and allow a better interaction between them and the community concerned with a given environment – either PETROBRAS workers or not –, and to disseminate information in a differentiated way according each user's profile.

1. Introduction

The Brazilian legislation regarding the environment determines that any project that might have a high-degree impact on the environment must be submitted to a specific process of environmental licensing.

PETROBRAS (Brazil's petroleum company), through COEMA (Environmental Engineering Coordination), an agency belonging to SEGEN (Engineering Services), had the need to implement an information system that allows the management of the licensing processes of the corporation' enterprises that have an environmental impact.

The SIGMA system provides communication resources that allow, in an easy way, information sharing, negotiations in cases in which divergences may appear, and experience exchange among members of the community involved in environmental licensing processes.

On the other hand, the corporation wished the enterprise to start in the shortest possible date, hence the need to accelerate as much as possible the conduct of the process. Thus, an important requirement is to establish automatic controls aiming to avoid unjustified delays, taking into account that fast information broadcast means expense economy to the corporation.

Despite the system's wide covering, it devotes maximum attention to information security, regarding both access to it and its integrity. For this, different kinds of users and different kinds of access to the information were defined, making the system available in a differentiated way according to the user.

2. Monitoring Mechanisms

The environmental licensing process consists in obtaining licenses with the competent agencies. This requires the development of several activities: (a) Preliminary Analysis Study; (b) Definition of the Reference Term, in which the scope of the environmental studies to be made is presented; (c) Environmental Study Elaboration; (d) Revision of the studies by the competent agencies, dissemination of information and public hearing when required; (e) Issue of the Previous License; (f) Issue of the Installation License, which allows the corporation to begin the construction stage; (g) Construction Stage; (h) Environmental Hearing; (i) Elaboration of Emergency Action and Risk Analysis Plans; and (j) Issue of the Operation License.

For this monitoring, the application was divided to two parts. The first one is identified by the inclusion, for each project, of cadastral data, of the dates corresponding to the activities, of the people responsible for them and of the restrictions involved. PETROBRAS has created three kinds of projects: ducts, industrial units, and production units. The projects concerning the ducts refer to the implantation or enlarging of ducts for the transportation of products such as gas, petroleum, oils, etc. The projects concerning the industrial units consist in the construction or enlarging of refineries, while the ones concerning the production units correspond to the construction or enlarging of platforms or terminals.

In this stage, the phases with their respective activities are selected. Each project has a set of particular phases/activities that might be different from another project's or not. This selection is made by means of the

fulfillment of the dates related to the activities, estimated and/or accomplished. It is also here that the information on the evolution of the management process are updated.

The set of phases available in the inclusion part follows a standard. The system doesn't allow the inclusion of new phases yet, but phases that will not be used in a given project could be excluded. There is also a default set of activities for each phase. In this case, the system allows the exclusion and/or creation of new activities in each phase. The exclusion of phases and/or activities and the creation of new activities are only valid for the specific project. Each project has its own set of information, all of which are stored in a data base and are recovered in real time when the user navigates through the application's pages of a given project.

The second part of the application refers to monitoring the environmental management process. There, the pages of the project, of the monitoring of phases/activities, and of the schedule are presented.

Schedule Charts

The schedule can be analyzed according to two concepts: the bar chart and the block chart, developed by TeCGraf (the Catholic University of Rio de Janeiro's computer graphics development team). The bar chart, presented in Figure 1, refers to the GASBOL project, which is the duct responsible for transporting natural gas from Bolivia to the South and Southeast regions of Brazil. It lists all the project's phases, being also available to each phase. The access to the bar charts is also made through the links existing in the block chart in the page of products being licensed or in the product's page.

In the project's abbreviation there is a link to the project's page. There are also links in the name of each phase, leading to each one's bar chart.

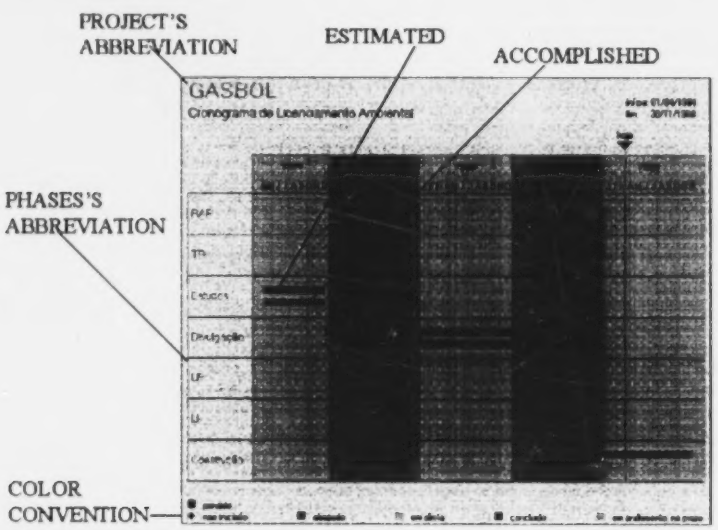

Figure 1: Bar Chart

The block chart presented in Figure 2 has two purposes: to present the project's situation, and to present the situation of the phases that constitute the project. Both cases inform the user about the situation of the project or phase by means of a graphic feature, detailed in Table 1, which allows a quick identification of the situation of the project or phase.

BEST COPY AVAILABLE

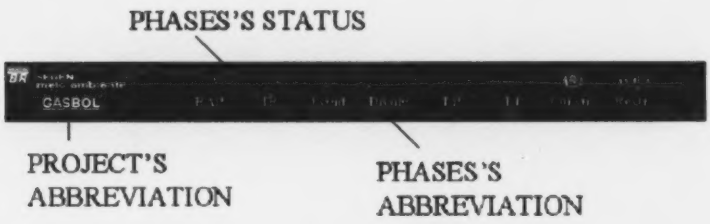

Figure 2: Block Chart

Below is the description of each symbol and its meaning. A particularly important one is the alert state, represented by the yellow ball in Table 1, which aims to inform the person responsible for the environmental management process that the final date of the activity is approaching.

	Symbol	Description
●	Green ball	The Phase/Activity is concluded
◉	Red ball	There is a delayed phase/activity
◆	Red lozenge	There is a non-started phase/activity whose schedule has expired
◉	Blue ball	There is a phase/activity in progress, in time
◉	Yellow ball	There is a phase/activity in progress, in time, whose end date is approaching; alert state
●	Gray ball	There are project/phases/activities yet to be initiated

Table 1: Symbols from the block chart

The monitoring of each activity is made through the project's page, shown on Figure 3 for the GASBOL project. This page presents information on the projects according to their kind. They include the entities involved with the people responsible for them. For each entity, there may or may not be a list of the ones responsible for the project.

The top of the page presents the project's block chart, in which the links to the bar chart and to the details of the phase selected are available.

The vertical frame to the left is called general index. It presents the links to recurrent themes when navigating through the application, such as sending an e-mail to the webmasters or consulting the system's user guides.

The second vertical frame (beside the general index), in Figure 3, is called contextual index. It shows the list of activities belonging to the selected phase.

The central frame is called main frame. It presents information to be consulted or for the forms to be filled by the user.

The system works with text files, such as environmental reports, study letters forwarded to Environmental Agencies, etc. In this case, the system makes available pre-defined files which serve as a base for the creation of new text files. The access to these documents is made by means of links that activate text editor MS Word, the one used by PETROBRAS.

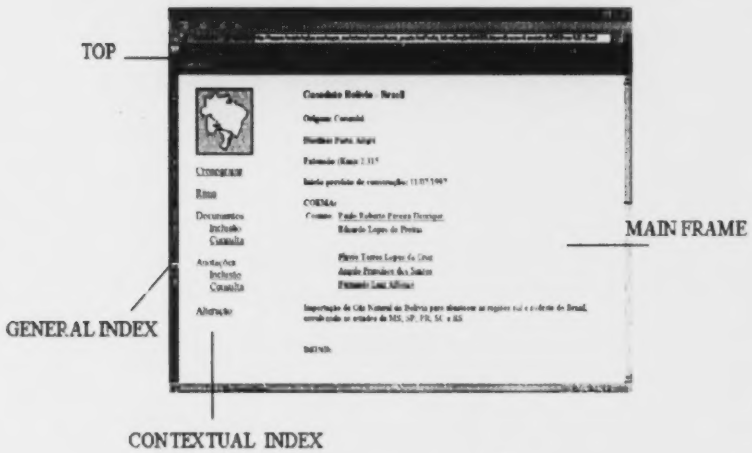

Figure 3: Project's Page

The documents received, including the licenses (Previous, Installation, Operation), will be associated to their corresponding projects. They will be scanned, treated, and stored digitally, becoming available in the system to be accessed by those interested and authorized. The documents will be scanned for any area, and, by means of upload, will be included into a specific area of documents for each project. In this case, the system automatically defines each document's name.

3. Communication Mechanisms

Communication mechanisms are the features through which the users can make notes concerning the project. In the note pages the users register comments during the execution of the projects under their responsibility, which become available in the system to be accessed by the people involved in the environmental management process, according to their profile. These notes are classified as individual, public, pertaining to a sector, pertaining to a project's community, and pertaining to the managers.

Access permission to the notes available in the projects is defined by the kind of note together with the kind of user that is trying to access. Based on this combination, the users might have access to the notes or not, both for reading them and for creating them.

The individual notes may be created by any PETROBRAS employee involved in the project, and may only be accessed by the person who created them. This kind of note aims to allow the users to write reminders or to make observations for themselves.

The notes pertaining to a sector may be created and accessed by the users belonging to the same entity of the person who made the note. Their purpose is to disseminate information on the project, so that those working in the sector involved in the project may be kept informed on what is going on.

The notes pertaining to a project's community may be created and accessed only by the users related to the project. It is one of the mechanisms that aim to maintain an interaction between the people responsible for the environmental licensing process and those relat to it.

The notes pertaining to the managers may be created by the users who are responsible for the project. These information is only accessible to those working in the high administration (superintendence and board of directors).

Public notes may be created by people from entities like COEMA, Enterprises, Coordination of Works, and Division of Projects related to the project. They may be accessed by any person belonging to the environmental community, either a PETROBRAS employee or not.

SIGMA also has links to consult other organizations, making available access to information from environmental agencies.

Beside the above mentioned communication mechanisms, electronic mail is also available to provide direct communication among the people involved in the process.

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4. Access Mechanisms

Due to the security needs demanded by the users regarding access to the system's information, differentiated visions were defined according to the their profile. The users are divided into: COEMA, Enterprises/Coordination of Works/Divisions, Operational Agencies (the clients), Superintendents/Directors, PETROBRAS' intern public, and PETROBRAS' extern public. For each of these users there are different levels of access.

The access level informs how users have access to the information specifically available for him. Level A allows the user to include and update the information concerning the projects under his responsibility, and to create any kind of note. Level B allows the user to consult the information regarding the projects under his responsibility, and to create and access specific notes according to the entity that he belongs to. Level C allows the user to consult cadastral information about all projects and specific notes according to the entity that he belongs to.

5. Conclusion

Groupware is a technology that allows corporate work between two geographically distant groups, propitiating a better and wider interaction among themselves [Khoshafian 1995] [Ostwald].

SIGMA is a groupware application. It enhances the interaction among those belonging to the environmental community, allowing them to exchange ideas, to share information, and to actually control the environmental licensing process of PETROBRAS' enterprises by means of three mechanisms: monitoring mechanisms, communication mechanisms, and access mechanisms.

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Visualizing the GLOBE

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Abstract: *We describe the functions and internal architecture of the GLOBE Visualization server. The server generates maps and graphs of environmental data for GLOBE, an international science and education program. Users can modify the visualizations to show any date, location or dataset, and users can customize the interface itself based on browser capability, native language, and familiarity with the system. Wherever possible, all options are self-generating to avoid separately-maintained content areas. We describe the system from the user's point of view. We then discuss how it is implemented on the server side, describing the interface, imaging, and database components.*

1. Introduction

The GLOBE Program is an international program of science and education involving students, teachers and scientists. Nearly 5,000 schools in over 60 countries participate. Students in grades K-12 perform measurements of environmental parameters such as temperature, precipitation, water quality, soil characteristics, and vegetation, and report them to the GLOBE Student Data Server. Teachers receive training on measurement protocols and Internet use, and return to their classrooms to oversee data collection by students [Soloway 1996]. The instructor can integrate GLOBE activities into the curriculum in whatever way is most appropriate for that school and country. The measurement types and techniques are defined by scientists affiliated with the program.

The GLOBE Visualization server at NASA Goddard Space Flight Center provides scientific visualizations for GLOBE. We use student measurements, and data and forecasts from other sources, as the basis for maps and graphs used by GLOBE students and by the public. The imagery is created on demand to the user's specifications. This paper describes the visualization system and its architecture.

2. Visualization Products

The GLOBE Visualization server provides maps and graphs. Maps show the geographic distribution of measurement values and are available at scales ranging from full-earth to 25x25 km in a series of discrete steps. As the user zooms in, additional context is provided by political boundaries, bodies of water, towns, and railroads. Maps are in spherical projection except for the full-earth Mollweide (equal-area) projection. The central latitude and longitude of the spherical maps is arbitrary and may be selected by the user to focus on the area of interest.

We display GLOBE data atop these maps. Student measurements are taken at specified locations in the vicinity of each school. The data values are displayed as colored glyphs centered at the measurement station and colored in accordance with a scale appropriate to the quantity shown. Some measurements may legitimately be interpolated to estimate values in areas between the stations; those data types can also be displayed as colored contours over the map. We also display reference (non-student) data for comparison purposes. Those maps are based either on numerical weather prediction model forecasts or on satellite estimations.

Besides maps, we also provide graphs of student data as a function of time. Each graph can display up to six parameters for a single school, or up to six schools for a single parameter. The time spanned by any graph is adjustable from the entire program period (April 1995 to date) down to a single week.

3. User Interface

The normal means of requesting visualizations from our server is via a set of HTML-based user interfaces (UIs). Two primary goals have driven the overall design of the system: allow fine-grained access to the data's space and time dimensions, and make the visualizations accessible to all users regardless of physical disability, bandwidth limitations, native language, and previous familiarity with the system.

Navigation

Fine-grained access means that we allow the user to zoom in on any map location and any graph week, to create maps for any single date, and to create graphs for any individual school. [Fig. 1a] shows a sample map interface. The top half of the page contains the map and the controls to make a new map. HTML menus are provided to change the map type, the dataset, the date, and the image size. Geographic navigation is accomplished by clicking on the image containing the map cut, annotation, and icons. The active areas are the map of data on the right (click to zoom and/or recenter to new latitude and longitude), the smaller locator map and surrounding arrows at top center (pan horizontally at the same zoom level), and the zoom bar in the center (zoom in or out at the same lat/lon). The lower half of the page contains links to related products such as a page showing the image by itself for printing, a legend explaining symbols on the map, and a facility for comparing two maps side-by-side. Below that is a GLOBE-wide navigation bar for access to parts of GLOBE besides the visualization server. (GLOBE comprises multiple servers at NOAA and NASA.)

The graphs have fewer parameters (datasets and start/end dates) than the maps, so the interface is correspondingly simpler.

UI revisions based on user feedback are continuously implemented. A new step-by-step option for beginners that progressively builds up the interface has been developed. Also, we are considering using Javascript to trap potential user errors on the client side.

Customization

To satisfy the goal of universal access, we offer several means of customizing the interface itself. The tunable parameters are graphical/text display mode, language, and help message display. These options are handled internally within each script; in particular, we do not have separate text-only and graphical content areas because they would tend to diverge with time. The state describing the user's preferences is encoded in the URL of the document [Iyngar 1997]. These interface options are user-selectable using hypertext links in the page footer (see [Fig. 1a]); we do not test for the myriad possible User-Agent request headers, nor do we use content negotiation as defined in HTTP/1.1 [Fielding 1997]. The default parameters are graphical display, English language, and no help messages. The footer also presents a list of mirror sites to choose from. We have duplicate servers on the East and West coasts of the US and in Germany; servers in Australia and Japan are in preparation as of this writing.

Text-Only Mode

Although our primary product is imagery, we are committed to allowing access to that product by text-only or

speech-enabled browsers. This goes beyond merely adding ALT attributes to images or omitting icons when text-only mode is selected, because geographical navigation is customarily performed by clicking on an image as described Section 3. Hence, we offer an alternative navigation scheme. When text-only mode is selected, the current page and map are replaced by a page containing (1) an anchor which references the bare image that had previously been displayed within the page, (2) new control widgets to select latitude, longitude, and zoom level, and (3) all the other controls previously available. Users can thereby type in the coordinates and construct the desired image without using the click-to-zoom procedure. Text-only mode also benefits users with graphical browsers because it allows direct access to a known location without generating images at intervening zoom levels.

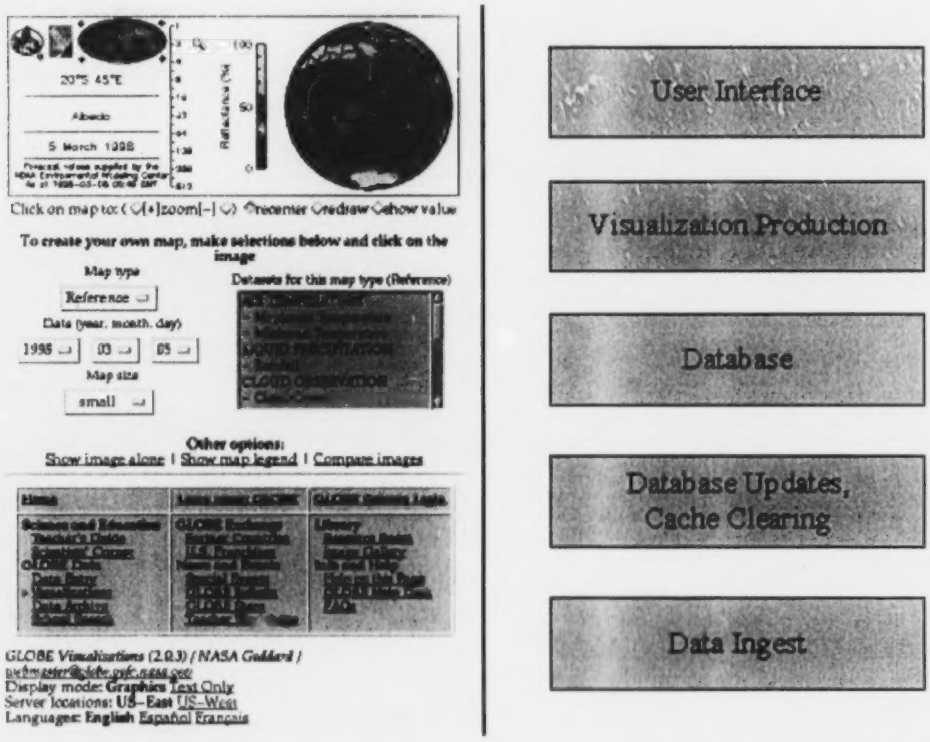

Figure 1: (a) Screen shot of the map interface, showing the map image itself, the widgets to modify map parameters, and links to related pages, the GLOBE navigation bar, and display customization options. (b) Conceptual diagram of the system architecture.

Translations

Because GLOBE is an international program, we are committed to offering content in languages besides English. We presently offer French and Spanish; Russian is under development. Each menu item, help message, or image annotation displayed with the imagery is represented in the software by a string variable instead of by a hardcoded phrase. For each language, we create configuration files that provide appropriate values for each string. Users select language via a link in the footer of every page, and the software reads the appropriate configuration file(s) at runtime.

Embedded Help Messages

To assist novice users of the interface, each script offers a help option. Rather than rely exclusively upon external help pages, which may become out of date and which cause the context to be lost when they replace or hide the page which caused the confusion, we have embedded the capability for each script to display its own help. In help mode, explanatory messages appear beside each widget or control. The interface remains

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functional, but the page is somewhat lengthened by the additional text. Thus, the user maintains context and can immediately follow the instructions. The messages remain enabled if the form is submitted to create a new map, and the user can explicitly turn off the help when ready. A set of more detailed external help pages is also available.

4. Technical Information

We now discuss the technical details of the implementation. As sketched in [Fig. 1b], the principal components are the user interface, a visualization engine, a data repository, database update, and raw data ingest. These pieces are written in a combination of Perl, IDL (Interactive Data Language), and C. We use SGI machines running Irix 6.x; mirror sites run Sun or HP machines. All sites happen to use the Apache HTTP server, but none of the code is Apache-specific.

Space limitations in this conference paper preclude going into complete detail. A more specific paper on the technical details of the system is forthcoming [de La Beaujardière et al. 1998].

UI Layer

The UI is generated by a set of Perl CGI scripts. Perl 5 is required. The primary scripts are used to generate the home page, the interface for one map or two maps, the graph interface, and the form to select schools for graphing. Additional scripts process and display static HTML template files and perform other miscellaneous tasks. This section will focus on the map interface; the implementation of the graph interface is conceptually similar.

A shared set of configuration files lists machine-specific options, defines all of the available datasets, provides language-specific phrases, and sets miscellaneous variables. These files are read as needed at startup time by each script using Perl's require() function. A collection of Perl files provides shared subroutines which are read as needed.

All CGI code was written from scratch, with many reworkings since early 1995. The code has evolved from standalone scripts which generate a collection of static pages [de La Beaujardière, Mitchell, & Hasler 1995], to CGI scripts which generated HTML dynamically while displaying a collection of static images [de La Beaujardière et al. 1997], to the present system with both HTML and imagery created on demand.

The CGI scripts accept data from HTTP GET requests in the usual manner. GET is used to allow hypertext linking or bookmarking of any page; the URLs are not long enough to require POST. The basic philosophy is to always show a map and the user interface to change it, so defaults are supplied if the user does not provide enough parameters. For maps the default is to show a small map of student maximum temperature, for the current day, showing the entire world, annotated in English. The CGI communicates with the database and the visualization engine to request an image, and when ready displays the image along with interface elements.

In HTML, the UI is implemented as a <FORM> with the visualization itself being the submit button (<INPUT TYPE=IMAGE>). The ACTION attribute of the form is the same script that displays the form, so the form essentially submits data to itself. When the user clicks on the image the x,y coordinates of the pixel are sent to the script, which determines whether the user clicked within the map area, one of the other active areas, or an inactive area. An active area functions as discussed in Section 3. An inactive area generates a map at the same location and zoom level. A click on the map itself requires a call to the visualization engine (described below) to translate the pixel coordinates to a latitude and longitude. The text-only option replaces the submitting image with <INPUT TYPE=TEXT> elements and a normal submit button.

At present we do not pre-start the CGI scripts using FastCGI, nor have we incorporated the software as Apache modules. The startup cost of the CGI scripts is much less than the time required to actually make the image, and server load is modest, so such optimizations have not yet been necessary. The CGI script for map display runs

in about one second. Image times are given below.

Visualization Engine

The visualization engine is written in IDL (Interactive Data Language), a high-level scripting language well suited for manipulating arrays and scientific data. Map-making functions are built into the language. There is substantial overhead associated with starting up a new IDL session, so we initialize a batch of IDL servers which await requests. We typically run 40 IDL servers at once. IDL version 5.0.3 is required.

The CGIs communicate with IDL using an RPC (Remote Procedure Call) interface written in C. Arguments are passed to the RPC driver, which chooses one of the available servers at random, issues the IDL request, and returns the name of the image just created. Images are cached until invalidated by a database update, so IDL first checks whether it has already made the desired image.

IDL uses its built-in routines to perform the transformation from pixel coordinates to latitude and longitude, which are then used to determine the new map center. When a particular flag is set in the request, IDL responds not by making an image but simply by declaring what the coordinates would have been. This allows us to query an existing map (say to find the schools near a point) without making a fresh image.

Besides displaying GLOBE data on a map, IDL must also show context data. We use a geographical database derived from the Digital Chart of the World (DCW) produced by the Defense Mapping Agency and the US Geological Survey. The DCW includes coastlines, primary and secondary political boundaries, waterways, city names and locations, railroads, roads, and urban area boundaries. More context data are drawn as the user zooms in. We currently do not show roads and urban areas because the latter are a large database and the three different cases of roads (light-, medium- and heavy-use) are three very big databases; extracting and drawing these features on the high-zoom maps would take more than a minute.

At low zoom, with little context data, a map of point data takes three seconds to be created. At higher zoom, with much context, a point map takes 11 seconds.

Data Repository

The data repository is currently in a state of flux. The GLOBE student data have until now been stored in a set of ASCII flat files with indexes, in a format devised by the Student Data Archive server. Access is fast and direct, but queries are limited by the available indexes. GLOBE is now implementing a commercial RDBMS (Oracle) on all servers, with rollout scheduled for September 1998.

The flat files are read by another set of Perl scripts which extract the requested data. These extracted files are read by the imager and subsetted to show the desired region or timeframe of interest. Extracted map files are cached to speed later requests; graph files are deemed too volatile to cache. For map data which can be contoured, the Perl extractor calls IDL to perform that interpolation. This contour computation is potentially lengthy (one minute or more), so the resulting files are also cached. Thus, the second request for the same day's contours is rapid. By default, maps do not show contours, but we precompute contours in the background in anticipation of a future request.

There is a second class of data which is handled differently. The reference (non-student) data are a collection of files in Hierarchical Data Format (HDF). The HDF files are compressed and stored in a repository on disk, and upon request the necessary file is uncompressed and moved to a staging area where it is read and from which it is deleted if unused for several days.

Data Ingest and Updating

Data ingest is handled by the GLOBE servers at NOAA (National Oceanic and Atmospheric Administration) and is not part of the visualization function per se. Nevertheless a few words are in order. GLOBE schools typically send data by filling in an HTML form on the Student Data Server. Schools may report measurements made on the current day or on any day(s) in the past. Data are validated and then handed off to the Student Data Archive for permanent storage. With the move to Oracle, each mirror site will be able to function as an ingest point, and updates will be replicated several times per hour among the various DBs. Currently, the primary Data Server in the US in the mirror site in Germany accept data input.

The existing flat-file DB is created by the archive server. Every hour, the visualization server fetches from the archive an update comprising new or changed records, new index files, and checksums to verify integrity. These partial updates are folded into the existing flat files. When new student data arrives, our update procedure determines which days have been rendered obsolete by new submissions; a single new data point invalidates the map for that day. Stale files are culled from the cache.

The update procedure for the reference data is different. New model run files are created essentially once per day by the NOAA Environmental Modeling Center. We archive them as they come in, converting the desired fields to HDF. The files are predictions, so there is no updating of earlier data.

5. Conclusion

The GLOBE Visualization server is a full-featured system for generating maps and graphs of environmental data on-the-fly. Users can modify the visualizations to show any date or location, and can customize the interface itself based on browser capability, native language, and familiarity with the system. Wherever possible, all options are self-generating to avoid the use of separately-maintained content areas.

The system architecture comprises distinct modules for the user interface, the image production, database access, and database updating. The pieces are written in Perl, IDL and C. An Oracle DB is being implemented. The system has been installed by three other groups worldwide and is known to run on SGI, Sun and HP machines. A Linux port in the works. (Perl and IDL are very platform-independent; only the C-language RPC must be explicitly ported.)

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URLs

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The GLOBE Program - general information: http://www.globe.gov/
GLOBE Student Data Server: http://globe.fsl.noaa.gov/
GLOBE Student Data Archive: http://globe.ngdc.noaa.gov/sda-bin/wt?ghp/archive

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Knowledge representation techniques for information extraction on the Web

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1 Introduction

The main facilities for a user to search within the enormous amount of information available in the Web are the so called search engines. Their limitations have been addressed in the literature and many proposals for improving their precision have been made. Because of the difficulties arising in precisely identifying the information needed through the query facilities offered by search engines, several other approaches have been investigated to make information in the Web more easily accessible to users (see [1] for a review). One approach to information access is to provide the user with a more semantically-oriented query language, such as data base query languages. The advantages of a more powerful query language come, however, with the cost of a much more difficult access and management of the information in the Web. From a data base perspective the problem can be viewed in a Data Warehouse setting, where the Web provides information sources than one can either access at query answering time or materialize in a view that is maintained locally [2, 3]. In both scenarios the user views the Web as a data base, and is relieved from a direct access to the information sources. The situation is depicted in Fig. 1.

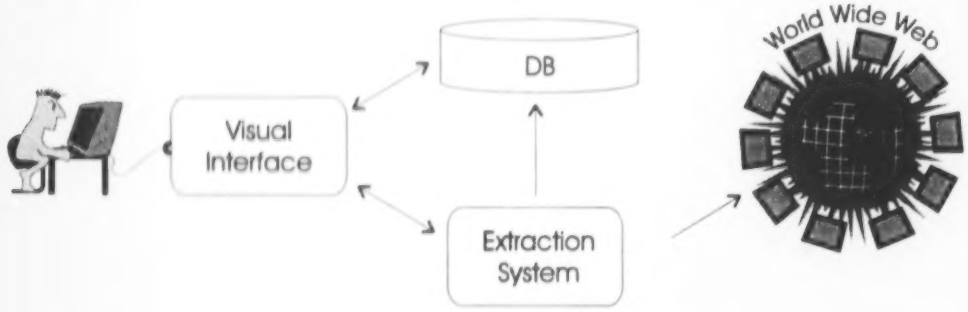

Figure 1: System Architecture

We have developed a system (see [4, 5]), that automatically extracts from Web sites information on a specific domain and collects such information within a database. In order to fullfil the requirements of usability the system provides a visual interface in the style of [6], where queries are formulated through an semantic data model diagram.

As already pointed out the critical aspect of such an approach is the extraxtion of information from the sources to make it available to a data base system. In the rest of the paper we concentrate on the Extraction System, investigating the possibility of integrating Knowledge Representation and Data Base techniques. The idea is the use of knowledge representation techniques for representing

both the domain of interest and the information sources in order to extract from them the relevant data, and a Data Base approach to provide a semantically-based declarative query facility.

The following sections address the problems involved with representation of information, the information extraction process and briefly comment on some preliminary results.

2 Representation

In order to access and classify information contained in Web sites concerning a specific domain of interest, one needs to represent the domain, the structure of the generic site and of the pages, and the terminology about the domain (see IJCAI 97 for a discussion on the role played by content, format and structure). There are many formalisms one can choose: simple formalisms are easy to process automatically but difficult to interpret (eg. feature vectors), whereas more complex ones are difficult to use but may allow for an automatic interpretation (eg. kwowledge representation systems).

Traditional systems for information modeling present some limitation: Entity-Relationship (ER) model are not suited to represent typical hypertext structures, while Object-Oriented (OO) model are more feasible, but still lack the flexibility needed to handle the variety of structures that one can find in the Web. We adopt Description Logics (DL) as a representation formalism, and the CLASSIC system [7] as a knowledge representation system based on DL. DL can be used as a modeling language, because of the close relationship with semantic data models, and also offer reasoning facilities to automatically classify concepts (i.e. entities).

2.1 Domain of interest

In order to enable the user to interact with the system at a very abstract level, we have chosen to represent the domain using a well-known semantic data model, namely the Entity-Relationship (ER) enriched with additional information about the generic site structure. It is worth noticing also that the attribute types that can be specified in the ER enriched scheme, range among those that the system can recognize automatically in the information extraction process: dates, addresses, phone numbers, names, etc. .

2.2 The generic Web site

The notion of relationship in the ER model provide some intuition about the possible structure of web site. However, some additional hints are needed in order to map an ER diagram into a site structure. In particular, one can specify a preferred direction for a relationship in the schema. With this information the system is able to turn the ER schema into a representation of the site structure expressed through the language of CLASSIC. In this step the semantics of the domain is combined with the information about how the domain is instanciated by Web structures.

The intuition behind this is that relationships are given a direction which corresponds to the links in the Web structure. At present this information is provided by the user, but we are investigating techniques to learn it automatically by analysing actual Web sites.

By weakening the representation we accomplish the additional task of turning the domain representation into a simpler one which gives us the ability to reason about hierachical strucures: intuitively, DL concepts correspond to entities, roles correspond to relationships and attributes of entities are mapped into DL attributes (roles with additional constraints).

For example, in a university domain, the concepts **Teacher** and **Course**, could be linked by the role **teach** or by the role **given by**, but typically in Web sites, information about courses can be found in the teacher's home-page, so the first role is preferred. Such a role gives additional hints to access data about related concept, for example following links, analyzing lists and tables, etc. .

Summarizing, we can model at the conceptual level the typical structural organization of Web sites relevant for the domain and the domain itself within the same representation. Moreover, by

using DLs we can face in a more general way the extraction problem by relying on the deductive services that they offer.

2.3 Vocabulary

The system can interpret the terms used in a domain's description, but in Web sites the domain's elements could be denoted with different names. Within the DL representation it is easy to specify synonyms and homonyms, as well as find more general and more specific terms using an approach similar to that of Wordnet [8].

2.4 The Web pages

In this work we are concerned with HTML structures, at present not addressing active components. The syntactic structure of a Web page is automatically built by a parsing process and represented in DL. Specifically a page is represented through a kwoledge base individual with an associated set of attributes corresponding to the syntatict structures identified in the page. We consider a set of syntactic structures such as lists, tables, headers, links, etc. and represent them as concept descriptions. Also with respect to the syntactic structure of the pages one can take advantage of the capabilities of DL to organize in a taxonomy the most common constructions. For example, in HTML there are six header types that differ in the way they are shown by the browsers and two link types, one that references an anchor and another one to identify the frames contained in a page. These relationships are represented through hierarchies.

3 Site Analysis

The overall representation described in the previous section is used by the system to analyze a Web site. The goal of this process is to populate a database that may thereafter be queried by the user.

The analysis starts with a page, represented as an individual of the CLASSIC knowledge base, and a concept expression, which is expected to be instanciated in the page. This concept will be referred to as the taget concept. In the following subsections we shall briefly describe the vocabulary normalization used to interpret text associated with HTML elements (links, headers, lists etc.), and the information extraction process.

3.1 Vocabulary normalization process

Typically, the terms that the system deals with in the analysis are simple words or noun phrases occasionally in a foreign language. Therefore, we do not apply Natural Language Processing techniques, but simply use a vocabulary and a domain's description to relate terms, specializing or generalizing them through the capabilities of the DL system.

The vocabulary normalization process is accomplished through the following steps. We first check whether the current term is in the vocabulary. If the term is a noun phrase every word belonging to it is searched in the vocabulary. Among all matched terms corresponding to concepts, the most specific concept which subsumes all of them is chosen as the meaning of noun phrase.

3.2 Information extraction

The extraction process aims at identifying the instances of the given concept in the given page and can be decomposed in an *extraction* and a *propagation* step. Before analyzing a page, the system performs a preprocessing step in which the concept corresponding to the current page is analyzed in order to identify frame structures. The analysis of a page is spli into the analysis of the embodied frames, with respect to the same target concept of the entire page.

3.2.1 Extraction

The extraction phase can roughly be divided in two parts, one in which textual or no structured data are analyzed and another one in which the structure part is analyzed. In the former one can only rely on pattern-matching procedure or NLP techniques to understand the terms involved, whereas within tables and lists one can take advantage of the structure regularities to interpret data. We shortly describe below the two mentioned types of analysis.

Attribute Analysis. In the attribute analysis the system gets from domain model the description of the target concept which is expected to be instanciated in the current page. The attributes associated with the target concepts are selected and the system tries to match them with the data contained in the page. If such a match exists new instances in the knowledge base are created for current concept.

Structure Analysis. HTML structures like tables and lists are often used within pages to represent homogeneous data related with page content. They can hold attributes of entities instanciated in the page (e.g. in a personal home-page one can collect birthday, address, email in a list structure), or instances of entities related with it (e.g. in a teacher home-page it is possible to find the courses he teaches and their schedule in a table). The system analyzes such structures trying to relate their content with a specialization or generalization of the target concept or concepts directly related with it in domain model, to create new individuals in the knowledge base.

To give an intuition of the approach followed to take into proper consideration the structure (syntax) of the pages while trying to capture its content, we describe in more detail the table analysis. Data stored in tables are typically organized in rows or columns and this is the natural assumption to be made when analyzing them, although the table structure is sometimes used simply to organize the space of the page. We call *heading* the set of terms that specify the data contained in the table (usually the content of the columns of the first row); we call *header* the text that preceeds the table and is usually meant to explain its content or highlight specific features.

The first issue to tackle when analysing a table is to find the heading, which is accomplished by looking at the data in the table trying to interpret them as elements of the domain. The vocabulary normalization process is again used here. Identifying a heading is a necessary condition for the subsequent analysis because the heading can be associated with a concept experssion for the target concept, while the header provides additional information that can be used to specialize the concept which we are trying to instanciate. Then, the concept expression characterizing the table is matched against the concept to instanciate. This matching is done through subsumption checks with the current concept and the concepts linked to it.

Once the concept that describes the data in the table is determined, it is possible to fully characterize the information stored in it. At this point, the table is scanned and for each row (column) the corresponding individuals are created and the relationships among them and other existing individuals are specified.

It is worth noticing that the semantic of the domain is repeatedly used to extract information from table. Moreover, this is done in a way that depends on the syntactic structures rather then being coded in ad hoc ways for a specific domain.

3.2.2 Analysis propagation

Once the current page has been searched for information to instanciate, the search is propagated by exploiting the information about relationships given in the semantics characterization of the domain.

The outgoing links of the page under examination are first normalized with respect to the vocabulary. Then, the pages reached through those links that match the ones modeled in the domain are further analyzed. The input concept becomes the one which the current concept is linked to. In this one the semantics of the domain is used to guide the search within the overall site. Secondly, among the links that do not match those in the schema, the ones whose associated

text matches the name of an existing individual are analyzed to gather information about such individual. This corresponds to verifying, when it is not possible to match a link name with a role in the semantic schema, whether the link name directly matches an already instanciated individual of another concept. The motivation beyond such behaviour is that when the system creates new individuals it has to give them a unique name for their identification. The content of an attribute indicated in the domain model as a key is chosen as a unique name for new individual. So when in the site there is a link which associated text correspond to an instancied individual we make the assumption that following such link we can gather further information for the individual.

The remaining roles of the individuals corresponding to page, relate the current concept with unknown ones. Such roles can be further analyzed looking for clues that allow to find new starting points for the analysis. Many different strategies can be applied and we are currently performing experiment on this aspect. The overall process resembles the rule propagation mechanism used in CLASSIC, and is terminated by checking that individual objects corresponding to pages are not analyzed twice.

3.2.3 Site analysis algorithm

We can summarize the overall extraction process in the following algorithm where domain model (DM) is supposed to be an implicit parameter and where PAGE_IND is the individual correspondig to the current page, CL_CONCEPT the target concept to be instanciated. Moreover, the procedure has a third parameter named CL_IND, which is used only when the propagation through links exploits the information about already instanciated individuals. The output of the procedure is constitued by the generation of instances of the concepts in the domain and are performed by the procedures AttributeAnalysis, TableAnalysis and ListAnalysis as side effect.

```
SiteAnalysis(PAGE_IND, CL_CONCEPT, CL_IND)
  BEGIN
    AttributeAnalysis(PAGE_IND, CL_CONCEPT, CL_IND);
    TableAnalysis(TablesContainedIn(PAGE_IND), CL_CONCEPT, CL_IND);
    ListAnalysis(ListsContainedIn(PAGE_IND), CL_CONCEPT, CL_IND);
    FOR each link L contained in the page corresponding to role of
        CL_CONCEPT in DM
         BEGIN
          IF page linked trough L is not yet visited
          THEN BEGIN
           NPI=individual correponding to the page linked trough L;
           NCC=concept related with CL_CONCEPT trough the role correspondig to L;
           /* start new analysis with new parameters */
           SiteAnalysis(NPI,NCC,CL_IND);
          END
         END
    FOR each link L1 contained in the page that corresponds to an instanciated
        individual in the knowledge base
         BEGIN
          IF page linked trough L1 is not yet visited
          THEN BEGIN
           NPI=individual correponding to the page linked trough L1;
           NCI=individual whose name is equal with text associated with L1;
           NCC=most specific concept NCI is an instance of;
           /* start new analysis with new parameters
           SiteAnalysis(NPI,NCC,NCI);
          END
         END
  END
```

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Fixing the mapping between enriched ER scheme and its DB implementation, it is possible to turn the knowledge base content into tuples to populate the DB. Such a process is done automatically by the extraction system.

4 Conclusions

To verify the capabilities of the proposed approach we have tried to retrieve the information automatically extracted by our system using search engines (SEs). We used Lycos, Yahoo! and Metacrawler relying on their particular features to focus the search in a limited Web domain (`.it` in our case), to exploit taxonomy organization of the Web space and to combine the results of several other SEs, respectively.

We submitted the same queries to SEs and manually analyzed the first 20 top ranked retrieved documents seeking for information automatically found by our system.

Despite the limited scope of the experiment, there are indications that the answers on queries concerning specific information (e.g. the phone number of a professor) are satisfactory, whereas SEs typically fail; moreover, in the domain under consideration (Univesity Departments) the system can acquire automatically a substantial amount of data.

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SLATE: Space for Learning and Teaching Exploration

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Abstract: Through the use of comprehensive instructional design and sophisticated information technologies, the University of Michigan School of Education has reinvented the way it educates prospective mathematics teachers. A new web-based instructional environment called SLATE (Space for Learning and Teaching Exploration) combines digital video, searchable transcripts, basic multimedia authoring, and other new media applications to provide a shared experiential frame and a range of investigation previously unavailable to student teachers. This document is also available online: murph.soe.umich.edu/SLATE/SLATE.htm

1. Introduction and Background

As part of their professional training and certification, every preservice teacher spends time in real classrooms under the close mentorship of cooperating practitioners. This apprenticeship period ensures that preservice teachers have had guided, first hand experience in live environments before embarking on careers with their own students. Furthermore, a significant element of preservice teacher preparation is the shared analysis and discussion of these preservice teaching experiences.

Unfortunately, preservice teachers' placement experiences often vary dramatically due to differences in the style and engagement of their mentor teachers and the classroom cultures into which they have been placed. This variance complicates the process of establishing a shared experiential "text" upon which to base methodological discussion. Faculty at the University of Michigan School of Education have recognized the challenges inherent in providing both live classroom placements for preservice teachers and shared classroom experiences for use in socially constructed knowledge building. Dr. Magdalene Lampert's *Mathematics and Teaching through Hypermedia (MATH)* project, Dr. Anne Gere's *Technology Assisted Teacher Education (TATE)* project, and now Dr. Deborah Ball's *SLATE* project are just a few of the initiatives that have sought to address this challenge through the use of emerging technologies. This paper describes the development and functionality of the SLATE project as well as some of the pedagogical underpinnings of the project.

SLATE was conceived in the Summer of 1995 when Dr. Ball began considering the inherent problems with shared context in preservice teacher education placements and how previous attempts to address the issue might be improved. Her discussions with technical staff were informed by close experience with earlier tools including the Student Learning Environment developed by Kara Suzuka under the MATH project (co-directed by Dr. Ball and Dr. Lampert and funded by the National Science Foundation and Michigan State University).

The resulting SLATE design draws heavily upon the Student Learning Environment, but also adds a significant number of features and tools previously unavailable. The Student Learning Environment is a HyperCard-based engine for accessing a variety of multimedia data collected over the course of a year in two elementary school mathematics classrooms. These data, including video and transcripts of the class sessions, digital images of student work, text of teacher journals, seating charts and standardized test scores (among other things), were gathered together and made available for student searching and incorporation into original multimedia compositions. The environment has a number of limitations however, including a lack of random access to all of the video (which is stored on laserdiscs), difficulty searching across the entire data set (for occurrences of a

particular text string, for example), a lack of robust student authoring tools (Microsoft Word and HyperCard have been used with varying degrees of success), and a lack of portability (the environment is difficult to setup and is sensitive to being moved).

After several weeks of analysis and discussion of previous environments, underlying instructional objectives, and technical constraints, a final SLATE design proposal emerged. The design was presented to the SOE/ITD Partnership (a joint venture of the School of Education and U-M's Information Division) which supported the project and sent it to the Office of Instructional Technology for development.

2. Technical Discussion

The completed SLATE environment consists of a several commercial software packages, a custom-developed environment manager, and custom server-side tools. Some specific features of the environment include:

• Access to collaborative assignments and notes from previous sessions is provided via an AppleShare server preconfigured for groups of students (arranged into cohorts). All student work is saved on the server, periodically reviewed by instructors, and backed up by project staff.

• Central control of the environment is provided via a custom-developed SuperCard application which communicates with the rest of the applications (Netscape, ClarisWorks, Adobe Acrobat).

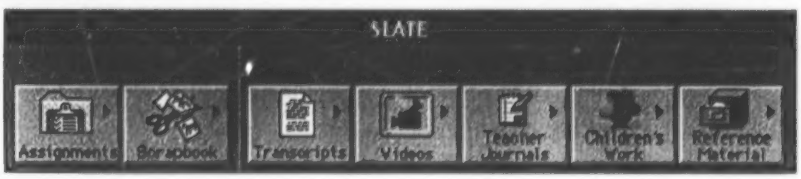

Figure 1: SLATE SuperCard application with pop-up access to media and tools

• High-quality video and corresponding transcript text is delivered to the desktop using MPEG playback and text-track features built into Apple Computer's QuickTime media technology. The video (and other environment media) is stored on an external 9 GB hard disc attached to each PowerMac 8600.

Figure 2: MPEG video and corresponding transcript presented in real time

• One-click transcript access to any point in the 30 hours of video is provided via a web interface.

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Figure 3: Transcript with links to video

• A web-based search engine utilizes HTML forms that are tied to a cgi search engine (which runs on a remote UNIX machine). Query results may be saved as HTML documents.

Figure 4: SLATE search engine

• Student authoring is facilitated through the use of predefined ClarisWorks templates. The ClarisWorks productivity suite provides drag-and-drop video editing, graphics manipulation and a full-fledged text editor for

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the creation of student multimedia artifacts.

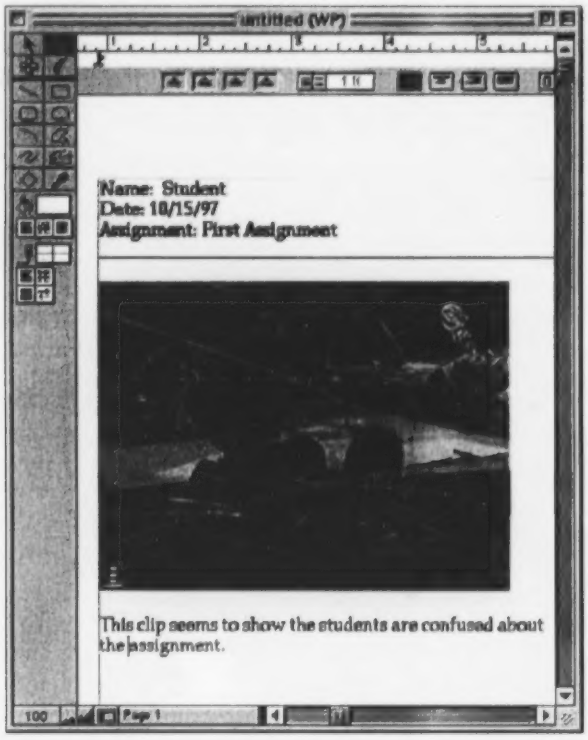
Untitled (WP)
Name: Student
Date: 10/15/97
Assignment: First Assignment
This clip seems to show the students are confused about the assignment.

Figure 5: Student ClarisWorks document with embedded MPEG link

• A browser interface provides access to a variety of other data, including digital images of student work, seating charts, and teacher journals which are stored in Adobe Acrobat format.

During development, three separate teams were formed to concentrate on different aspects of the project. A technical team concentrated on software development issues and worked with a content team to address instructional objectives and overcome technical constraints. A facilities team directed the construction of the deployment space and ensured compliance with technical specifications.

It should be noted that SLATE was deployed in a new, high-end multimedia classroom designed specifically to support Dr. Ball's pedagogical approach which emphasizes collaborative exploration and discussion. The room, built in conjunction with the SLATE environment, was also supported by funds from the SOE/ITD Partnership.

3. Budget and Staffing

The development of SLATE has enlisted the services of numerous instructors, software designers and facilities professionals. An accurate estimate of total time invested is difficult to supply. However during the two years that transpired from the initial discussions in the Summer of 1995 to deployment in the Fall of 1997, the following rough staffing statistics were gathered:

Task	*Hours*

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Instructional design consulting	200
Project management	200
Production work (video capture, transcription, graphics translation)*	150
Development/coding (OIT)	250
Testing and deployment	100
Documentation (student guides)	50
Total Hours:	950

Table 1: Staffing hours used on the SLATE project

* Much of the media used in SLATE had been captured, cleaned and edited by previous MATH project efforts. For example, all of the video used in SLATE and the accompanying transcripts existed in edited form on laserdisc and in computer files. Had development of these media been necessary, the production effort for SLATE would have ballooned into thousands of hours.

Although the hourly rate of the staff involved in the project varied, an overall project budget of $35,000 has been spent to date. It should be noted the instructor time does figure into these staffing numbers. The instructional staff (faculty and graduate students) did not track their involvement, which almost certainly matched that of the technical staff and would likely double the total presented above. Obviously the staffing costs do not include the construction or outfitting (machines and software) of the multimedia classroom or any of the servers used by the project. If included, these infrastructure costs would add a half million dollars to the total project cost.

4. Summary of Outcomes

SLATE was deployed to four sections of Elementary Math Methods (Education 411), each containing 30 students, in the Fall semester of 1997. To ease the integration of the technology into the course, a detailed syllabus and course prospectus was delivered to students. Significant effort was made to communicate to the preservice teachers that SLATE is not intended as a replacement for actual classroom teacher experience, but rather that it provides an avenue to some of the shared context that would be the basis of classroom discussion. This sharing of a virtual classroom in parallel with the students' real placement experience, was a resounding success. Dr. Ball and her graduate student staff reported a level of discussion and engagement previously unseen in their courses.

The design philosophy of using off-the-shelf applications (as opposed to custom development) resulted in an uncommonly stable instructional environment. Furthermore, the leveraging of usability innovations such as drag-and-drop video editing, alias-based server access, and predefined document templates facilitated a new level of ease and sophistication of multimedia authoring. The technology also complemented the instructional approach of using collaborative learning teams, group exploration of the environment, and well-structured assignments.

5. Next Steps

Although the initial deployment of the SLATE environment was highly successful, a number of technical and non-technical next-steps have been identified.

A significant non-technical area of effort that will be undertaken is the recruitment of additional faculty to use the environment in different courses. Because the database does not contain explicit content codes (all data is coded based upon intrinsic characteristics such as date captured and type of media, not content abstractions like "multiplication" or "disagreement"), SLATE is generalizable to a variety of course topic areas. A faculty member interested in ethnic and gender issues, might for example, approach the environment with an entirely different set of investigational intents than a mathematics instructor. The development of a non-content specific guide to using the environment would significantly increase the likelihood of additional faculty using SLATE.

On the technical side, further documentation needs to be developed to allow instructors to more fully use the capabilities of the various tools in the environment. Knowledge of the text search and image manipulation tools built into Adobe Acrobat and ClarisWorks for example, may significantly enhance the instructor's ability to support and evaluate more sophisticated student work. Further testing and bug fixes, code normalization and minor feature enhancements round out the items for continued development.

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The Space for Learning and Teaching Exploration was developed under the direction of the Mathematics Teaching and Learning to Teach project, led by Dr. Deborah Ball. SLATE was developed at the University of Michigan by the Office of Instructional Technology and funded by the School of Education in partnership with the Information Technology Division. More information about the MATH project, upon which some elements of SLATE are based, may be found online at www-personal.umich.edu/~jmerz/MATHproject/math.html

The SLATE team is composed of U-M School of Education staff, faculty and students, and staff of the Office of Instructional Technology:

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Office of Instructional Technology, Information Technology Division:

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Faculty's Perceived Influences for Incorporating Web-Based Technologies in Teaching Practices

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Abstract: Innovative methods to persuade and influence faculty to adopt the new instructional technologies need to be implemented within higher education. Many studies have been performed to document how the obstacles to technology integration in higher education could/should be overcome (Snyder, 1995; Thompson, 1986; Comer, 1986). However, Snyder (1995) notes that although many faculty members throughout the country have overcome obstacles and have successfully integrated instructional technologies into teaching practices, these experiences are largely not well documented.

This study will identify what the primary influences were for faculty who are early adopters of integrating instructional technologies, particularly web-based technologies, into their teaching practices at the University of Tennessee, Knoxville. Findings from this study can help faculty development professionals within higher education work with administrators and others to develop innovative methods of influencing more faculty members to begin incorporating instructional technologies into teaching practices.

During this session, I will report the preliminary findings of this study. By early November, a survey will have been completed by selected faculty members at the University of Tennessee and personal interviews will be in progress with a sample of the survey participants.

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Intelligent Knowledge Gathering and Management as New Ways of an Improved Learning Process

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Abstract:
This paper gives a short description of a working prototype of an intelligent background knowledge broker as an enhancement module of the Web base training system GENTLE [Maurer and Dietinger 97a, Dietinger and Maurer 98a]. The dynamic and the static library represent a most relevant knowledge repository, which is automatically enlarged and improved by the users themselves according to their needs. The gained relevant information is used to improve the learning process and to support the courseware authoring.

1. Introduction

At the Institute for Information Processing and Computer supported new Media much research has been done in the field of information and document management, computer based training, digital libraries and electronic publishing over the last two decades [Maurer and Schmaranz, 94, Marchionini and Maurer, 95, Maurer and Scherbakov 96, Maurer 97a , Gütl et al. 98a]. Research results and intense co-operation with the industry even led to commercial products like e.g. Hyperwave [Kappe et al. 94a, Maurer 96]. Based on these experiences a group is currently developing GENTLE [Maurer and Dietinger 97a, Dietinger and Maurer 98a], an electronic lecturing system combined with a digital lecture library for teachers and students. GENTLE has already been tested by hundreds of students at the Graz University of Technology. The feedback gained during the lectures is leading to continuous improvements of the system as well as the new research concepts.

One of the experiences we made was that the introduction of new technologies like multimedia or hyperlinked objects alone does not necessarily lead to more effective and more efficient learning. The technology should be used as a cognitive tool to enable entering into the area of creativity, problem-solving, analysis and evaluation [Watson and Tinsley 95, Pivec and Rajkovi□97a] . Cognitive tools are in fact any technology that enhance our thinking, problem-solving and learning [Reeves 97a]. When computer programs are used as cognitive tools, students use software to analyse problems, tasks, organise unique knowledge representations and share what they have learned with others. For that learners need interpersonal communication, the opportunity to ask questions and discuss problems with the tutors and co-learners. On the other hand technologies are also very useful and necessary for finding proper information, creating courseware and providing a digital background library.

A future oriented collaborative learning system has to provide a smart workspace for teachers and learners. Collections of lessons as well as asynchronous and synchronous discussions related to specific lessons or topics

are represented on the learning platform. Additionally an annotation system allows teachers and students to make remarks to sections of lessons. One lesson we had learned from former projects is that such a collaborative learning system also has to provide a digital background repository. Such a background knowledge system should consists of a static library (e.g. digital books, journals) as well as a dynamic library (e.g. indexing web sites, discussion forums and human expert knowledge database). The combination of above mentioned elements to a huge knowledge repository allows teachers and students to get additional and much more detailed information for each lesson. This includes, of course, enlarging the annotation system to make arbitrary references to the background repository as well as annotating the background information itself. On the other hand particularly the dynamic background library gives teachers a smart possibility to update lessons or even extract and combine information to new one.

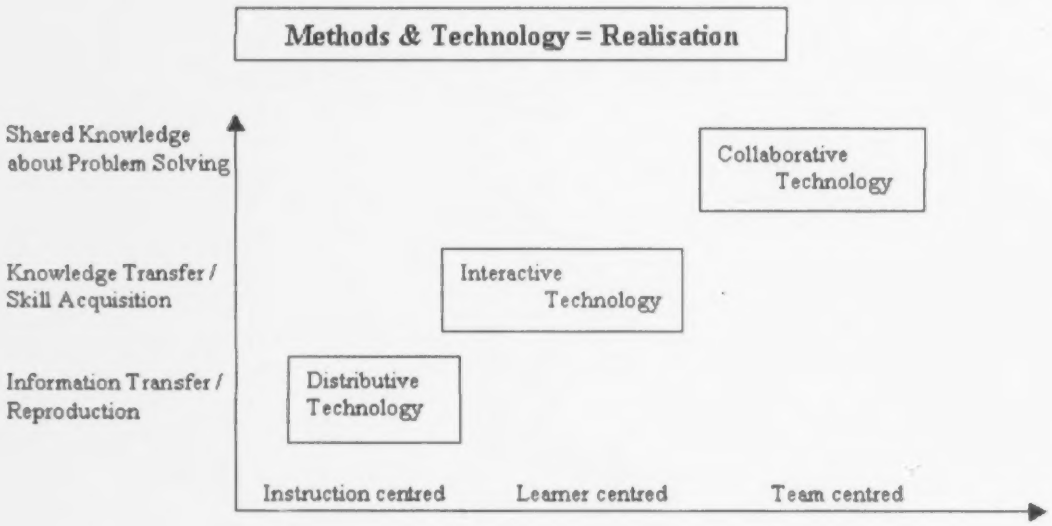
The background library based on HIKS (hierarchical interactive knowledge system) [Gütl et al. 98a] as a necessary and important part of a future oriented collaborative learning system will be described in more detail in the following sections. Aspects, related to the dynamic component by web sites and human expert knowledge are especially highlighted.

2. The Background Library and the Interaction to Learning Process

Learning is a goal oriented process. By methodology we can distinguish between following types of learning methods:

1. Instruction centred (learning by telling)
2. Learner centred (learning by doing)
3. Team centred (learning through discussion & reflection; team – work seminars, case studies, field studies, projects, simulations, discussions)

Combining these methods shown above with available techniques allows to deduce varieties of realisation concepts to reach the postulated goal.



(**Figure 1:** Interaction of learning methods and knowledge transfer)

Generally the knowledge acquisition is a bottleneck in the construction of proper knowledge base. Therefore re-using and re-modelling the already existing modules and knowledge for educational purposes brings certain advantages for developing courseware. Knowledge Based Courseware (KBC) is per definition a courseware with a separate knowledge representation and is considered as an innovative approach which applies established

techniques from the field of AI in order to overcome some of the limitations of the standard CAL (computer aided learning) or CBT(computer based training) approach [Anderson et al., 90, Valley 95a, Pivec and Rajkovi 97a].

However all those techniques need a proper information structure for preparing knowledge or allow to search and inquiry answering open questions and solving problems. Nowadays our society could be described by the so-called information society. It is characterised by a very huge unstructured information repository as well as the rapid increasing of information. In the last few years the internet has become a very interesting area for publishing and gathering information and must be included in such a future-oriented learning environment. The current number of web pages can be estimated to exceed 150 million [Gütl et al. 98a] but only gathering these information do not satisfy the users' needs. The main problem is to get the right information with proper quality, reliability and actuality and to get only that information that has been requested (knowledge). Rieder [Rieder, 97] addresses this deficit by saying *"Not only is the gathering of information demanded; this information must also have meaning ..."*. So we must change from information society to knowledge society [Gütl et al. 98a].

The introduced background library should be an important step into direction of knowledge society. Teacher and learners are motivated to rise the creativity level by using the knowledge for problem solving and generating new concepts as well as to use it by adding more details to each lesson. Therefore the learners e.g. may inquire on background knowledge base for solving concrete exercises. On the other hand teachers e.g. are allowed to add references on their lessons. The system includes digital books and journals as well as human-based knowledge databases and indexed relevant web sites. Former experiences have shown that the static component (digital books and journals) provide a solid base but e.g. rapid increasing of information claims also for a dynamic component (human-based knowledge database and indexing of relevant web sites).

The human-based knowledge database could be seen as a collection of specific information related to lessons, topics or terms. The sources of such information could be an answer-question process between learners and teachers, former exercises and additional explanations as well as problem solutions, studies, etc. An important point related to the learning process is that a most relevant knowledge repository is provided and will be continuously enlarged and improved by users' needs. On the other hand indexing of relevant web sites provides a huge and always up-to-date repository. Most relevant web sites (first named by teachers) related to lessons or topics are gathered and indexed periodically. Learners and teachers are allowed to name further web sites and assess the quality of information. An important feature related to the learning process is that always a wide range of additional information is available and up-to-date. Teachers e.g. can get latest know-how or can update lessons. Learners are highly motivated inquiring on such repository to solve problems or get their additional information.

The introduced system combines the already common courseware, synchronous and asynchronous discussion and a smart annotation system with a highly-sophisticated static and dynamic background library, explained in much more detail as follows.

3. An System Overview

The collaborative learning system provides a smart working environment for learners, teachers and courseware authors. The learners can use courseware lessons as well as discussion and annotation systems. The synchronous and the asynchronous discussion system allows collaborative working between learners and teachers as private, group-oriented and public communication. Most relevant discussions corresponding to specific topics could be included in the background library assigning keywords and an information level (beginner, advanced, expert). E.g. a student who does not understand some parts of a lesson and discusses with the teacher about the problem. In case of relevant information to others, it can be added to the knowledge repository. Therefore further relevant information is provided and can be used for inquiring by other students. Quite similar is the question and answer process related to courseware lessons. This information is directly embedded or marked concerning to the corresponding subject of the lesson. Of course this information could also be added to the knowledge repository.

The annotation system allows remarks to lessons and other documents as well as remarks to background libraries and even to annotations themselves. The system provides private, group-oriented and public annotations and a proper information level could be assigned. These information could also be added to the background library

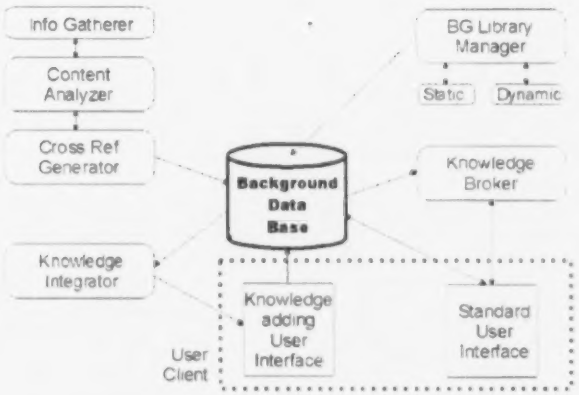
including keywords and an information level. Another tricky feature allows to include pieces of the background knowledge as parts of annotations. The teacher e.g. adds an annotation related to a subject (a definition for beginners) by including information from a digital book and by assigning the information level "beginner" to it.

Of course the system also provides a private workspace and a virtual learning environment. Learners can copy (much more exactly it is a symbolic linking) actual lessons as well as integrate additional information from the background library and prepare their own documents. The learning environment supports co-operative learning and problem solving. E.g. one student is going to provide a presentation by publishing it digitally on the system. Students can include always up-to-date knowledge from the dynamic library by defining predefined queries. The private workspace allows teachers to create new courseware, presentations and so on. One system's tricky thing is that the static background library as well as the dynamic background library could be used to deduce lesson content and thus produce new or update already existing courseware. When integrating such a lesson the system parses for keywords and suggests possible links to further information. Both features are provided by modules of the background library and a tool allows to choose the right keywords and the proper links combining with the information level (see also next Chapter).

The background library represents an important and useful module of the collaborative learning system. There are more points of contact as already shown. The background library will be discussed in more detail as follows.

4. The Background Library

The introduced learning system uses a background library which consists of a static and a dynamic component. The static library provides electronic books, journals, etc. and represents a set of information which has been already reviewed but must be kept up-to-date. The dynamic library provides the human-based knowledge database as well as the indexed web sites. The human-based knowledge repository is composed by most relevant discussion contributions, question-answer processes, former exercises, studies, etc. Usage and work of the learning system guaranties for such information users are needed at their learning process. The information quality will be determined by persons who are allowed to record new information into the system. The gathered web sites represents an additional information repository. Only indexing pre-selected sites could be seen as first steep to higher-level quality of such information. Further quality assessment, annotations and revised indexing will improve the quality too. Like the courseware, all components of the background library are searchable. Also the system allows to annotate specific information at the static library as well as the background library.



(**Figure 2:** Background library and modules interaction)

The modules function and interaction will be considered on the basis of (Fig. 2). The *info gatherer* gets information of selected sites and follows embedded links restricted by host and URL filters. Each gathered page is added by a time-to-live attribute to guarantee up-to-date information. Not only the content and embedded meta information are indexed; the content analyser extracts keywords as well as the description automatically and

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adds this meta information to each object. Furthermore the extracted keywords are filtered by relevance. Only keywords with low frequency in a specific course may become relevant keywords. To make this point clearer let us have a look at an example: in a Javascript course it does not make sense to include "Javascript as keyword" and therefore have to be filtered; on the other hand a HTML course may include the keyword "Javascript" as a relevant one. A tricky thing is that relevant keywords (corresponding to a specific course) may be used to create new lessons in two ways. First is that the new lesson will also be parsed by the content analyser and the system suggests a set of keywords and a description. The second is that the new-lesson-tool provides references or links to further information related to relevant keywords (see also following paragraph). With that the creation of courseware is supported and, on the other hand a smart set of information is built, inquiring background knowledge. Of course full-text search as well as keyword and title search is provided. Besides the content and meta information there is another source of information taken into account: the description of the web server or the whole site itself.

The system has also implemented a special *cross reference generator* that automatically detects potential hyperlinks and inserts them if the course authors themselves have not already done it. We are speaking of a so-called vocative hyperlink. One of our future work is to combine this vocative hyperlinks with information levels. Therefore learners can define the level settings of their own user preferences. This technique allows the learners to get in touch with the subject by selecting the beginners level. Advanced learners however only get links to higher-level information to prevent getting bothered by uninteresting basics.

The *knowledge generator* allows to deduce new knowledge by recycling in the background library already existing material as well as including relevant information out of discussion forums, question-answer processes, studies, etc. A group could be defined by user rights to create new or edit old ones. This user group gets an additional interface, the knowledge-adding user interface. This set of collected knowledge represents the human-based knowledge database. Learners' problems and interests as well as teachers' established priorities influence this set of knowledge. Like the gathered web sites also the human-based knowledge database provides full-text and keyword search. This source of knowledge could be perfectly used by learners following the shown learning process (see " The background Library and the Interaction to the Learning Process")

The *background library manager* handles all necessary activities concerning the dynamic and the static components. An overview of functions concerning the dynamic library (gathered web sites and human-based knowledge repository) was described in former paragraphs. As already mentioned the static background library consist of electronic books and journals. By including a new electronic book also keywords and descriptions to each document (book's paragraph or chapter) are built. Both, additional meta data combining content and other available meta information, are indexed and therefore searchable. Further work will be done on using information levels to provide level depended references at courseware environment. The collection of journals are working quite similar as described above. Both components of the knowledge repository provide a relevant base for learners.

The *knowledge broker* represents the user interface inquiring and searching in the background library. Of course the courseware and annotations search are also provided but in this paper the background search should be closer examined. Let us consider one learner who is going to solve a problem. The system allows to search on a limited scope, e.g. to search only in human-based knowledge databases. Considering another example: one is preparing a presentation and is looking just for brand-new information about a specific topic. Therefore the search scope could be set to gathered web sites. The combination of the set of different knowledge sources results in a highly-sophisticated inquiring tool for teachers and learners.

5. The Users' View

The introduced future-oriented learning system provides a set of tools supporting courseware authors and teachers as well as learners. Not only a courseware environment is needed; also a smart background library providing many features as shown in former Chapter.

The courseware author can use background libraries inquiring specific information to create new or update existing lessons. The system supports authors by suggesting keywords, description, links and references.

Furthermore relevant information by discussion or question-answer process can be used to deduce "recycled information".

Learners can use courseware itself as well as the annotation system and discussion forum. Also the background library provides a huge source of knowledge. In addition different views and different sets of functionality are controlled by the so-called user preferences. Preferences like information level, multimedia component selection (text, sound, videos), language information and group information are taken into account. For example one learner could be described by a beginner, preferring textual information, wants to get only German-language information. Setting proper attributes the user only gets specified information. Getting only that information prevents frustration to the user.

6. Conclusion and Future Work

As we have seen above simply combining multimedia material and hosting it on the Web does not lead to a good WBT system because it lacks interactivity and moreover is difficult to manage and keep up to date for a longer period of time.
By adding static and dynamic background libraries we do not only provide a profound additional knowledge base for learners to widen their horizons but also a huge data collection for courseware authors to create new courses.
Apart from that the contents of these libraries are automatically organised and updated by providing contributions through the users or through the system by gathering information from other relevant sites and by adding vocative hyperlinks within the information structure.
One of our future works is to combine these features with information levels according to the users preferences (e.g. talent, learning style, language, etc.), to increase the relevancy and quality of the provided knowledge.

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COPYRIGHTING CYBERSPACE: UNWEAVING A TANGLED WEB

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The Internet was once a research project. Today it is the largest computer system in the universe. Also known as the *net* or *cyberspace,* this super highway to the stars offers a variety of useful information as one navigates down its ocean of URL's, browsers and hyperlinks. With advanced technology comes new legal issues to battle. The age of information has given rise to greater concerns about copyright law. Although it would appear we are headed to a Star Trek-like world, we need to address fundamental areas so vital to educators, business people, computer professionals and the like before beaming too far into our future.

The age of intellectual information dissemination via cyberspace has clearly arrived. There are those who side with the infamous *White Paper*, the creation of the Clinton Administration's Working Group on Intellectual Property/ Infrastructure Task Force. On February 26,1998 HR 2281, the Clinton administration's alleged solution, made its way to the Judiciary Committee from the House Subcommittee on Courts and Intellectual Property. The bill is among several measures presently before Congress such as HR 3048, The Digital Era Copyright Enhancement Act and HR 2652, The Collections of Information Antipiracy Act (passed by the House on March 24,1998).

Government intervention and private rights seem to always butt heads in this and many areas of legal society. I am not advocating a circumvention of law. Nor am I in favor of total abandonment of existing standards, regarded as totally obsolete by some. However, with the rapidly developing technology some concessions must be made by all concerned. No law will be able to effectively cover all situations. Nevertheless let us try before finding ourselves too entrenched in this Net of wonder. It is far better than finding ourselves caught in a net and left to merely wonder.

Using Metadata to Improve Organization and Information Retrieval on the WWW

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Abstract: Until now the growing volume of heterogeneous and distributed information on the WWW makes increasingly difficult for the existing tools to retrieve relevant information.
To improve the performance of these tools, we suggest to handle two aspects of the problem:
One concerns a better representation and description of WWW pages, we introduce here a new concept of "WWW documents", and we describe them thanks to metadata. We'll use the Dublin Core semantics and the XML syntax to represent these metadata. We'll suggest how this concept can improve information retrieval on the WWW and reduce the network load generated by robots.
Then, we describe a flexible architecture based on two kinds of robots : "generalists" and "specialists" that collect and organize these metadata, in order to localize the resources on the WWW. They will contribute to the overall auto-organizing information process by exchanging their indices.

1. Introduction

On the WWW, many search tools are now available to help users access information more easily. But these tools are giving often irrelevant responses as they do not focus on the particular context expected by the user.
What do we mean by context?
Suppose that a user wants to know ten very well-known sites dealing with *environment*. He may ask with:
`Q1 = environment`
The answer to query Q1 contains many correct matches, but they are lost in a lot of noise. AltaVista gives back some 3 000 000 responses matching the word environment, containing pages dealing with computers, ecology and other topics. These different answers are embedded within different conceptual domains, which are part of their respective contexts. But the contexts are generally not explicit in the inqueries, nor they are recognized during the flat indexing done by usual robots. Moreover, even if the result contains pages dealing with environment, these pages are not organized, i.e. we cannot have a resumé of the sites which contains relevant information, inducing difficulty to exploit the responses.
Suppose that another user looks for information on *water treatment* . He can try the query:
`Q2 = water treatment`
Q2 induces noise, because *water treatment* occurs within both the medicine and the environment domains.
So, he can try to refine his query by adding the contextual word *environment*, leading to query Q3:
`Q3 = water treatment + environment`
This time, he or she would get silence because pages containing only *water treatment* and not *environment* are not retrieved. In this case, the context *environment* was implicit and did not appear on the pages, but was explicit in the query.

To help capture the semantics associated with each site, we propose to redefine the concept of a WWW document as an abstraction of a set of page which can be organized into different hierarchies of clusters. We introduce metadata that describes the documents at an apt level of granularity.

Then we propose to define a flexible architecture using the existing and available search tools on the WWW which will enable everybody to participate in the improvement of document descriptions. This architecture is based upon high interactivity between search tools and progressive organization of information on the WWW. With minimal effort we can use cooperation between existing isolated elements of the WWW, resolving the problems of scalability of centralized servers, networked bandwidth overload, while improving the quality of information retrieval on the WWW by reducing noise and silence.

2. Related work

At present, information retrieval on the WWW is made by search tools that have limited capabilities.
Two kinds of tools are used currently :

2.1 Universal robots

These robots are "universal" in the sense that they try to index the whole Web, no matter what topics are addressed by the pages, or where the pages are localized. As the WWW grows, universal robots become more numerous, resulting in overload network bandwidths. They become inadequate in finding relevant information all over the WWW. Their main weaknesses are:

* too many irrelevant responses,
* no organization in the responses leads to difficult way to exploit them.
* loss of context around the responses because of the lack of semantic description while indexing and the lack of expressive request (terms with boolean operators),
* no access to the non-textual documents (images, sounds, video) which are not indexed.

2.2 Thematic directory

Other search tools exist, such as Yahoo, which provide users with the means to browse a hierarchy of thematic directories. A provider can register by filling a form to describe its site, indicating in which topic he wishes his server to appear and at which particular level in the tree of subjects. The advantages of this process is to enable exploratory research and better control in indexing (reducing the noise). The problems encountered by this approach are:

* manual indexing,
* only a part of WWW is indexed, so there is lot of silence in the answers,
* manual classification of the universal information requires manual and high cost for maintenance and updating,
* no content-text indexing of pages.

2.3 Metadata

The use of the tag META in HTML page has been solicited. The aim is to give the creator the possibility to insert in his pages the indexing information to be used by the robots. Moreover these metdata should be inserted in every page leading to both a work overload for the creator and some noise in the answers. Currently, meta tags have no standardization. There is no conscensus of meaning and the users unintentionnaly or deliberately can circumvent the use of these form of metadata. Recently, research has showed a great interest on using the metadata to improve the description of electronic documents and to standardize the exchange of this metadata. For example, applications have been developped to access digital libraries through the Internet, combining text and structured fields (author, abstract, title...)

indexing within a distributed architecture (see [Witten 1996]), but have not been extended to the whole WWW [Cifford 1997]. Currently, metadata have been formalized to add semantics only on pages or data, (see references as MCF [Netscape 1997], [Luke 1997],[DC 1995]).

3. WWW documents

The WWW pages are linked in a ``flat" way, so there is neither hierarchical organization nor overall structured information. HTML structures the display of pages, but provides very little information about the content of pages or collection of pages; it is precisely this structured content we want.

3.1 What are WWW documents?

Consider the following analogy :
A librarian needs a list of words to describe the books he/she has to catalogue and a classification (for example the Decimal Dewey classification or DDC) in order to put the book in its right place on the shelves. What we call a document in this context is in general a paper document, which can be easily identified as a physical unit of information.

Let us consider now a WWW document. This kind of document is electronic and has no clear physical boundaries. For example, is a WWW page considered as a document [White 1996]? In fact, there is a great diversity in the granularity of information found on WWW servers. You can find very short and independant pages, considered as documents by themselves, and pages linked to other pages that form a cluster or another document.
We give a new definition of a *WWW document* : a document is a collection of pages or documents, created by an authority (e.g author or organization).

3.2 Describing WWW documents

We introduce now the notion of a context around a page or a document : Each page or document has a context associated with. Let's go back to the library example, and consider a paragraph of a book. This page takes place in a section, within a paragraph, within the book itself. Each level of organization of the book gives a context, from the highest level (root is the book) to the next level in the hierarchy up to the page level. These contexts may inherit from their father context, depending if the attributes are dynamic or static (this will be defined later). The contexts are composed of both pieces of information about the content of the document or external to that content. For instance, at the book level the author name, the publication date and the title are outside its semantical content.
So we suggest to make explicit these contexts and their attributes within documents, The following figure shows how the WWW pages can be organized into clusters called documents, one page can belong to different documents, therefore bounded to different contexts (here represented by the subject attribute).

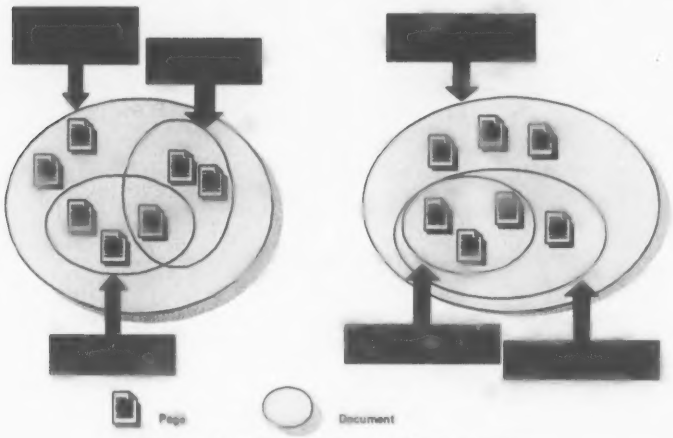

Figure 1: Several organizations of pages

Contexts are in fact represented by what we called metadata in the precedent section. Introducing metadata within a document rather than within a page has several benefits :

* describing the logical unit of information at a correct level of granularity ; enabling the author of the documents or experts to explicit the context associated with the documents;

* offering a better control over the structure of the WWW by making explicit the organization of documents;

* enabling flexibility of clusterization of pages, which correponds to several organizations of the same collection of pages;

* avoiding to duplicate the same information in all the pages which belong to the same document; therefore lightening the author work load.

The contexts have different attribute types : *static* and *dynamic*. Static means that the metadata is local to the context, then it will not be propagated along the tree of documents. Conversely, dynamic attributes means that they can be forwarded along the hierarchy. For example, coming back to the [Fig. 1], we can see that for the subject attribute, the word *Pollution* specializes *Environment*, and *Water Pollution* specializes *Pollution*.. *Environment* is forwarded along*water pollution* and *water* by inheritance.

Each author may have a certain view of the organization of the information within his pages and is responsible for the creation of the corresponding documents descriptors, or metadata. Each document contains a collection of pages or documents and is described by a set of attribute-value pairs. These metadata are based on XML for the syntax and on MetaData Dublin Core for the semantics. This is an example of the document metadata:

```
<XML>
<environment-document>
        <identifier>#env001 </identifier>
        <subject>
                <scheme>
                        <thesaurus_GEMET>    Environment    </thesaurus_GEMET>
                        <DDC> 333.7 </DDC>
                </scheme>
        </subject>
        <title> Environment server </title>
        <author>
                Bich-Liên Doan and Michel Beigbeder
        </author>
        <description> enterprise and teaching server about environment. </description>
        <subject>    Environment, pollution, water treatment </subject>
        <relation>
```

```
                <identifier-scheme> URL </identifier-scheme>
                        <type> contains </type>
                        http://www.emse.fr/ENVIRONMENT/environment.html,
                        <type> child </type>
                        http://groseille.emse.fr/ENVIRONMENT/files/d1.txt,
                        http://groseille.emse.fr/ENVIRONMENT/POLLUTION/d2.txt,
                        http://groseille.emse.fr/ENVIRONMENT/TREATMENT/d3.txt
        </relation>
</environment-document>
</XML>
```

The basic element for the representation of descriptors of documents is the inclusion relationship with other documents or pages. These relationships are represented with the relation (type = child, type = contains) attribute. With this attribute, it is possible to represent hierarchies of documents.
The subject attribute is another important one. The value of this attribute can be described with the DDC for instance. With such a scheme, any ambiguity of terms is avoided, but the author can describe freely by keywords terms as well with the subject attribute without any scheme. Let us come back to our three first requests :

```
Q1 = environment
Q2 = water treatment
Q3 = water treatment + environment
```

In contrast with the classical search tools, we produce the following results : Q1 returns the documents described by the *environment* subject. Q2 gives the set of pages containing *water treatment* embedded within *medicine* or *environment* documents.
Q3 returns the pages containing *water treatment* in the *environment* context.
We can now suggest how the use of metadata associated with documents can be helpful in a cooperative architecture of search tools.

4. Specialist and Generalist robots

4.1 Definitions

* Universal Robots : Universal robots currently exist on the WWW (eg. Alta Vista, HotBot, Lycos), although most of them include complementary topical search, they are keeping on their well-known function of indexing whole pages of the WWW.

We define two further kinds of robots : robots for general purpose tools and robots for specialist tools.
* Generalist Robots : They create an overview of the WWW by achieving two functions :
o first, they collect the metadata of whole sites on the WWW and they index descriptors of WWW documents,
o second, they manage an acquaintance database of services (addressed by other generalists and specialists) in order to route the queries towards the right services.
* specialist robots : They have knowledge in a particular domain. They use the metadata to decide if they are interested or not in exploring subtrees and indexing pages.

Our concept is based on high interactions between the entities defined above which form a specific structure. Each of the specialist robots is described by its own metadata (like a document) and can be requested by other specialists or generalists; the hierarchy of documents is then extended to the hierarchy of specialists. The robots are able to cooperate using the metadata specified in the last section. The advantage of this structure is that specialists or generalists may use metadata instead of the documents themselves for building their indices, thus reducing the network load. In this case, it is possible to improve answers to general queries (those that give thousands of answers): if a query generates 10000 URLs located on 100 sites, it is probably better to return the metadata associated with these 100 sites

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rather than a (poorly) ordered list of 10000 URLs. Such non-specific queries should be addressed to the generalists. Reciprocally, well-defined queries should be addressed to specialists.
In this section, we will detail what exactly are the roles handled by the entities in our structure.

4.2 Roles

4.2.1 WWW sites providing metadata

A WWW site stores a set of WWW pages. If metadata is embedded within an existing hierarchy of documents then a site may provide :

* one or serveral organizations of pages and documents
* metadata describing pages and documents, that specify :
  - o One classification scheme (e.g DDC), or a thesaurus if used
  - o The Meta Dublin Core fields, in addition with the number of pages or volume of the site.These metadata may be stored within the site, at the root place or may be a reference to a URL stored somewhere else, for example maintained by a specialist.
* a fingerprint of others specialists which have already indexed it.
* a standard robot.txt file

4.2.2 Specialists

A specialist is created when needed to provide an identification, a description of his domain. It may contact a generalist to ``push" information about itself. Its main function consists in gathering and indexing information about its specific domain, and more precisely :

* collecting metadata according to its subject (for example environment),
* indexing HTML pages associated with the knowledge domain,
* storing and managing metadata and indexing pages (updating, deleting data...),
* routing requests to generalists if it cannot answer the query
* publishing its own metadata, to be later indexed by other robots.
* answering by giving either pages or summaries of documents, so that the user can navigate the hierarchy of contexts linked to the retrieved documents.

4.2.3 Generalists

* collecting metadata from one or several specialists while maintaining references to these specialists
* directly collecting the metadata from the WWW sites
* routing the refined queries to the adequate specialists or providing summarized responses to general user requests,
* adopting a political decision to collect all the metadata on the internet or not.

4.3 Architecture

Suppose we have two specialists S1 and S2 dealing respectively with environment and pollution. Consider now the W1 site which fills S1 and S2 in environmental data, with metadata and pages. G knows S1 and its knowledge domain, whereas S1 knows S2 which is more specific than itself.

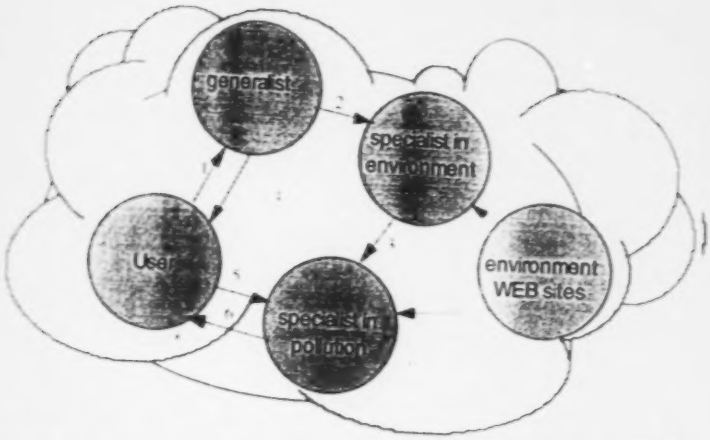

Figure 2: Interactions between specialists and generalists to answer a user need

* The user asks a generalist Q3. Q3 is translated to subject = environment, keywords = treatment + water.
* The generalist finds one specialist in the environment area. He contacts S1 and transmits the request.
* S1 knows another specialist, S2, whose area is specific to ``pollution of water". He transmits Q3 to S2.
* S1 gives the user a collection of documents and pages he retrieves from his local database and shows the context of his responses with the description of S2 included.
* S2 gives the hierarchical tree of concepts to the user.
* The user requests S2 for more detailed information.
* S2 searches his database and gives results to the user.

5. Conclusion

Defining structured metadata embedded within the documents should be used for organizing information and improving the construction of general indices. Here we have defined a scalable architecture which offers the present search tools the ability to index quickly and with better control. Our structure has the following advantages:

* Decreased consumption of the bandwidth. Robots exchange indices and may only index summaries of documents;
* More relevant answers. The contexts attached to the documents are hierarchically organized, involving interpretation and analysis of the structure and the content of the server;
* Distributed indexing. Specialist robots are focusing the information upon one particular domain;
* A self-configuring system. Specialist and generalist robots are discovering metadata from each other.

We are currently implementing a prototype of specialists and generalists for an environmental application project.

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Using CD-ROM andthe Internet for Classroom Support
A Successful Experiment in Accounting Education

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Students usinginteractive media learn the same amount of material in half the time orless with equal or better understanding and equal or longer retention thanwhen using traditional means of instruction. This statement summarizes literally hundreds of well documented and wellcontrolled research studies. A few years ago Congress allocated over amillion dollars for research into the effectiveness of interactive media.The Institute of Defense Analysisproduced a lengthy metastudy that analyzed over 600 research studies onthe effectiveness of interactive media. The results of this study aresummarized in the first sentence of this article.

For the past six years at the Graduate School of Business of the University of St. Thomas, we have been developing an interactivefinancial accounting course with the support of a number of corporations inMinneapolis. In addition, New College, the University's outreach to adultlearners, has developed a *weekend college format* in which adults capable of independent learning spend only half the numberof classroom contact hours as traditional students during the regularprogram. For weekend students, class participation is supplemented byindependent study.

In the Fall of 1996, an introductory financial accounting course wastaught in the *weekend college format* every other Friday night from 5:00 to 9:30. Students used a CD-ROM and aninteractive Web site in addition to a textbook. A regular section of the same course was taught by the same professor during the day using the sametextbook and class outline. Both classes took the same quizzes and tests.The students in the traditional class knew nothing about the CD-ROM orinteractive Web site, although they spent twice as many class contact hours with the instructor.

This was done partly for convenience and was by no means a scientificstudy. No variables were controlled, and there were obviously demographicvariables (what kind of student would choose to take a class on a Friday night?) and other intervening variables. However, theresults of this practical experiment were very consistent with results ofscientifically controlled studies.

The students in the *weekend format* sectionusing the Web site and CD-ROM did substantially better on all tests and quizzes than the traditionalsection. There was also a nearly perfect correlation between frequency ofcontributing to the Web site and their final grade based on the tests andquizzes. The more the student contributed to the Web discussion (which was available twenty-four hours aday seven days a week), the higher the student's grade.

It became apparent that the responsibility for learning shifted fromthe teacher to the learner for the students in the weekend format. Students came to the orientation session and first class or twowith the traditional attitude, "OK, I'm here; teach me." By the third class(about midterm), they came to class with questions. "How does ... work?""In the company I work for, thusand such happened ... how does that fit in with this

new concept we'relearning?" "I don't understand ..." The rapid fire lectures grew intodiscussions with specific learning objectives set in the syllabus andspecific objectives each student wanted to achieve. By the end of the course, the lecture format was almost entirelyabandoned, although discussions were sometimes interrupted by shortdidactic explanations of specific complex concepts.

Ever since John Dewey espoused progressive education, many teachers have attempted to encourage students to take responsibility fortheir own learning. However, the combination of less class time and thestructure of the Internet caused this to happen naturally. Studentsrealized that if they were going to learn the subject, they had to do it themselves - a very empowering motivator. Thefreedom actually seemed to generate responsibility.

In some cases the student's self-concept inhibited learning onthe Internet. During the first few weeks it was extremely difficult to get students to post their questions on the Internet for "everybody"to read. No learner wants to appear stupid. Asking questions on the net isa risk that most students find hard to take. In a typical class manystudents are unwilling even to verbalize a question in front of their classmates. Asking them to post a questionon the Internet for everyone to read is exponentially more difficulty. Thepotential for embarrassment is a significant inhibitor to learning.

On the other hand, the risk of embarrassment can be a motivator. Students reported that before they put aquestion up on the Internet, they were careful that their grammar andspelling were correct. Frequently they would check in the book or severalbooks and often found the answer to theirquestion. Or, in the process of framing their question, a better questionoccurred to them, which they posted on the Internet.

The greatest motivator for those who preferred not to participate orpost questions or comments on the Internet seemed to be their grade. If a substantial percent of their grade depended on theirparticipation in Internet discussions, the amount of participation (andtheir understanding of the material) increased substantially.

Many other discoveries were made as these learning technologies haveproliferated throughout the university during the past year.

The Internet and World Wide Web is the most recent popular media forinteractive learning and communication. Technology will change oureducational system dramatically. Our grandchildren are likely to learn accounting by sitting in their rooms, puttingon helmets and gloves, and flipping a switch to activate the system.Instantly they will enter a virtual world designed to help them learnaccounting. For example, they might be"hired" in an entry level job and given a task, suchas recording accounts receivable and sending out invoices. As the studentsets about the task, they can ask their "supervisor" or"coworkers" how to do the task(s), why the task needs to be done, and how it fits in with the rest of accounting department and company. Everyone inthis 3D virtual community responds as a patient teacher and gives thetheoretical as well as practical knowledge that helps the student developskills needed to do the job. The nextjob (i.e., unit) might be in the accounts receivable department, orinventory control department, or another accounting department, until thestudent eventually gets promoted to be manager and is asked to analyze thefinancial statements. The classroom teacher will act as a mentor, guide, advisor, evaluator, and tutor throughoutthis learning process. The student/teacher relationship is likely to revertto the Mentor/Telemachus model described by Homer, and is likely to be acloser personal relationship than the current relationship allows.

Sound incredible? Most of the pieces of this model are alreadyavailable. When IBM assembled its PC, it obtained the CPU from Intel, theoperating system (DOS) from what is now Microsoft, the monitor fromPerceptronics, the disk drives from Syquest, the Keyboard from Keytronics, and parts frommany other manufacturers. Henry Ford, like many individuals and companiesthat "invent" revolutionary complex products, used a similar approach. The CD-ROM andinteractive Web site are just two components of the future system. They may well be just a stepalong the way toward more effective learning based instruction that willreplace teaching based instruction.

EMC/Paradigm Publishing has adopted and published the materials usedat the University of St. Thomas.

Instructors can visit the ParadigmAccounting Interactive Web site at <http://www.emcp.com> (College Division, Electronic support). Instructors can also obtain afree CD-ROM demonstration disc for Paradigm Interactive Accounting bycalling (800) 535-6865.

Some observations about the CD-ROM and Web site

(1) responsibility for learning shifted from theteacher to the learner;
(2) emphasis shifted from teaching to learning;
(3) the level of classroom discussion became much more sophisticated;
(4) the Socratic method of asking worked better than telling orexplaining;
(5) the role of the instructor changed from one of lecturer toone of mentor and coach;
(6) instructors' office hours and time in class were optimized; and
(7) ancillary use of the Web site that was not integrated intothe core of the class was ineffective.
(8) Internet access was a problem for some students who didn't want tocome to the college. Studentaccess has increased at stunning rate during the past year.

A good example of an exchange on the Interactive Web Sitewent like this:

Assets vs. Owners Equity

Laurie - 02:38pm Sep 18, 1996
I'm having difficulty understanding the difference between assets andowners equity in a business.

Amy - 07:28pm Sep 18, 1996 (#1 of 5)
It helps if you change the equation around such as Assets -Liabilities = Owners Equity. I don't know if this is 'legal' but it helpsme to understand what Owners Equity is. It is the retained earnings from the previous year and information regarding stocks (how much in stocks, whatthey are worth and how much was paid in dividends)

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Using VRML for Teaching and Training in Industry

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Abstract: Lifelong learning and training has become an important issue in industry, because keeping track of innovations and adopting new developments is necessary for maintaining competitiveness in the market. In this paper we want to show how VRML can be generally used for teaching and training in an industrial context. We will discuss some aspects of learning and training in industry and sketch several application scenarios for VRML based training. Moreover we give an overview of tools that are suitable for designing teaching and training applications, and present authoring tools we have developed in this context.

1 Introduction

In industry, lifelong learning and training on an individual, team and organizational basis in all hierarchy levels from top management down to the work force is becoming increasingly important due to ever faster changing market dynamics, the rapidly evolving labor market and the constantly changing employment culture. Internal training of personnel, initial training and preparatory training for new tasks, the continuation of employee education, and also training on the job are the key forms of individual training. Team training often consists in special training courses on group dynamics and psychological aspects, but also includes the use of communication supporting software solutions that provide some assistance for efficient team communication. For instance the use of WWW technology as a basis for sharing information and documents, or the use of visualization techniques, aiming to provide a common understanding, can be classified into this category.
Organizational learning and training often comprises the problem of knowledge representation and collection, especially in internationally operating companies and in companies that have historically evolved from mergers and buy-outs of different enterprises. For such organizational learning and training, well defined and globally accessible information systems are often a favored concept, for propagating factually transmissible information. Apart from internal training, external training of suppliers and sales agents on new products are other frequently occurring training situations. For global organizations it is an increasingly complex and difficult task to maintain an overview of the "strategic knowledge" the company and its affiliations and subsidiaries own.
In the course of globalization of markets, an increasing number of companies rely on global communication networks such as the WWW for communicating internal information and for building up company wide information systems. Due to recent technological developments in the IT sector, the quest for more compelling visualization and information access is increasing and the demand for 3D graphics is rising. Innovative technologies such as *VRML (Virtual Reality Modeling Language)* [VRML97] enable the web based use of interactive 3D environments. VRML is applicable in different training scenarios, such as virtual training environments, both real time interactive 3D and immersive VR or hypermedia environments.
In this paper we first describe the state of the art of VRML. After that, we present tools that are suitable for creating teaching and training applications using VRML, and show some application examples.

2 VRML State of the Art

The Virtual Reality Modeling Language (VRML) is a language and file format specification for exchanging 3D data, especially across the Internet. Since its inception in 1994, VRML, as an open and platform independent

format, has gained widespread acceptance and support in both industry and academia. With its ISO standardization, finished in record time in November 1997, it has taken the step from de facto to de jure standard. By now, there exist numerous VRML browsers and plugins on many platforms, typically free of charge. Several dedicated VRML authoring tools are available. Most industry standard modeling and animation tools support VRML format, at least through export filters, and even more are supported through converters.
VRML offers among others the following features:

- description of 3D geometry, including material properties and textures
- fog and light effects
- linear key frame animation
- user interaction with the 3D scene (e.g. through mouse clicks or drags)
- 3D sound
- animated (i.e. video) textures
- HTTP hyper links
- programming APIs for the Java and ECMAScript programming languages

The further development of VRML is coordinated by the VRML consortium [Consortium] and is carried out in working groups, such as the Humanoid Animation WG or the MPEG-4 Integration Task Group.
VRML is supported by the common WWW browsers Netscape Navigator and Microsoft Internet Explorer by means of "plugins" or "ActiveX controls". This means that VRML data can be integrated into WWW pages much like other multimedia file formats such as MPEG video or Macromedia Shockwave files. Moreover, HTTP hyper links and multimedia files such as sound (WAV, MIDI) or MPEG video can be integrated into the 3D scene, so that VRML is tightly integrated into the WWW hypermedia structure. This can be used to advantage by applications such as product information systems, which can be set up to provide 3D presentations of products, where additional information can be obtained by clicking on different parts of the 3D object.
An even more powerful way of integrating VRML into the WWW browser environment is the *VRML External Authoring Interface (EAI)* [Marrin 97], which makes it possible to access and modify a VRML scene from within a Java applet running on the WWW page. Many applications such as 2D user interfaces for manipulation of the 3D world, database access, or simulator linkage, are thus feasible.
Despite the increasing availability of authoring systems and supporting tools, VRML content creation is still a very labor intensive and time consuming process. The manual tasks such as editing of the VRML scene file and especially Java programming are often unavoidable even with today's tools, and require special knowledge, such as programming skills. They are therefore often not done by the same people creating the 3D models, which makes VRML content creation even more expensive.

3 Applications

3D animation and Virtual Reality can be applied in industry as a medium for vocational training and for continuing education in the context of lifelong learning. For instance, in order to train technicians, engineers, but also users on a newly launched product or on special tasks to be performed with that product, such as installation or maintenance, manuals and courses are usually provided.
The use of VRML for such training manuals allows to take advantage of features such as a true 3D representation of the product, the display of animations showing special actions to be performed, the definition of interaction and behavior, the integration of links to additional information, or the addition of sound, such as spoken instructions.
In repair instructions for technicians, 3D animation and annotated, interactive 3D exploded views of the product model can be of great help to intuitive understanding. The same technology can also be used in 3D installation manuals and user manuals. 3D exploded views of product models are of great help to intuition and are already widely used for intra-organizational communication, marketing and management presentations of all kinds. However, the generation of such views is still expensive and thus reserved to a small number of special areas. Efficient methods and tools for generating interactive exploded views will enable their routine use in a larger context, such as 3D interfaces to product information systems.

In the same way VRML, as a web-based technology, is well suited for distributed information access and offers the option to use 3D interfaces. To access technical information on a product or on its parts, a 3D interface that shows an exploded 3D view of the product is a very compact and intuitive interaction metaphor. Because programmed code can be easily integrated into VRML scenes and objects, the VRML representation of the product and its parts can be dynamically related to additional information, such as a part list or bill of materials, where each entry in the list can be dynamically related to the parts in the VRML model.
3D navigation interfaces, representing a product or production plant, are well suited for training applications due to the intuitively and immediately understandable metaphor. They can be equally used for training of new personnel, anticipant training on new products and on new production facilities. VRML applications are also suitable for mobile environments [Raposo 97]. VRML can be used to share one model with other employees via WWW. For instance, in construction, several engineers can work together on the same object. The same technology may also be used to communicate shared mental models [Stout 96]. VRML can be used for surveillance of production processes. Here sensor data can be used to automatically generate to a time-variant 3D visualization. Presenting the sensor data in a 3D model makes it easier to locate a malfunction in the real machine. Additionally, the 3D model can also be used in a training scenario.
Providing technology and tools, however, is not sufficient. In industry, cost effectiveness is usually a major concern. The authoring of 3D environments has to be done in an efficient manner. Animation, for example, is not considered as central as in traditional application fields of computer animation such as film and entertainment. This implies for instance that in the industrial application context a dedicated animation or network expert may not be available. Thus, easy to use authoring tools and support for automated generation is of special importance. At the economical level one main argument for using 3D/VR training environments is that they are often less expensive than real life training environments, while providing similar training quality, and offering the option of distributed access—the trainee does not have to be present in one specific place in order to participate in the training. Furthermore, instruction material may be collected and offered at a central point in the company.
In some industrial areas, the timely training of personnel on the distribution, installation and maintenance of new products is mission critical. For these time critical applications, it is essential that the training material be provided in time, i.e. prior to the launch of the product. In order to ensure this, the process of generating a training application must be parallel to product design.

4 VRML Authoring and Application Building Tools

We have developed enhanced VRML authoring and application building tools, suitable for creating interactive, annotated and animated VRML based applications such as training environments and information systems. One example is the CASUS system, which offers a linkage between industrial simulations and VRML. Other examples are authoring tools that support the automated generation of 3D exploded views of complex models and allow to embed the VRML application in different contexts using different interaction metaphors. These tools include a scene composing editor, a VRML structure editor, an animation editor, and an application builder.
The VRML authoring tools described in this section are realized in Java and work in conjunction with any VRML97 compliant browser supporting the VRML External Authoring Interface.

4.1 CASUS System

CASUS System [Luckas 97], an acronym for Computer Animation of Simulation Traces, is an object oriented approach to linking a three-dimensional visualization to an event-oriented simulator. The goal is a realistic visualization, which is, therefore, well suited for learner-oriented presentations. This is achieved by using computer-generated, three-dimensional animation. In realizing this approach, a modular concept is provided which allows—apart from offering easy adaptation to a variety of simulators—a highly automated animation generation.
CASUS System as a whole was designed to remedy the lack of visualization capabilities of many event-oriented industrial simulators. Since nowadays the presentation is primarily done with numeric tables or abstract symbolic visualization learners are very often unable to evaluate the results and develop own strategies or interpretations. Moreover the learner is forced to get involved with abstract simulation models and presentation tech-

niques. CASUS System solves this problem by establishing a link between the abstract simulation and the real world. Based upon event-oriented data, an automatic translation into dynamic animation sequences is established, making use of animation elements [Dörner 97], clipart-like predefined 3D objects with integrated behavior. Both the simulation expert and the trainee receive an adequate and meaningful presentation of the simulated problems and solutions individually adapted to their specific knowledge.

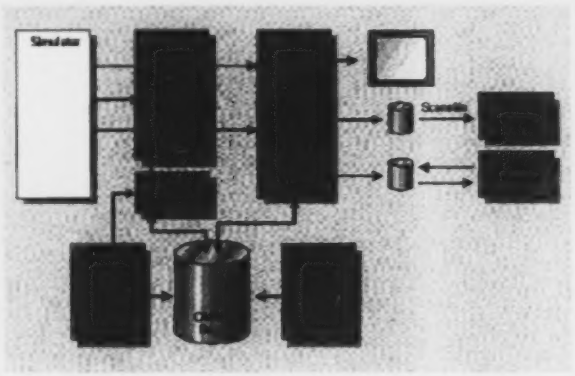

Figure 1: System Architecture of CASUS System

The architecture of CASUS System is based upon a pipeline that consists of an arbitrary simulator, the translator (CASUS Trias), the animation system (CASUS Anim) and different visualization systems, such as CASUS Presenter or CASUS Render [Figure 1]. At first the output of any event-oriented simulator is processed by the Translator CASUS Trias. Since there is no standard format for storing simulation traces a normalization tool is used. Referring to the normalized trace, this tool translates the simulation events into unified animation sequence descriptions. All animation sequence descriptions together form the animation script that is then processed by the animation system CASUS Anim. CASUS Anim allows the author to modify presentation parameters such as camera position, lighting, visualization time or frame rate, as well as the output format used, e.g. VRML. Therefore CASUS Anim offers a user interface that only provides the functionality that is essential for the user profile described earlier. The animation generation process is completely hidden from the user. Internal features, such as routing of events inside the VRML scene or reducing scene complexity, are maintained automatically by CASUS System.

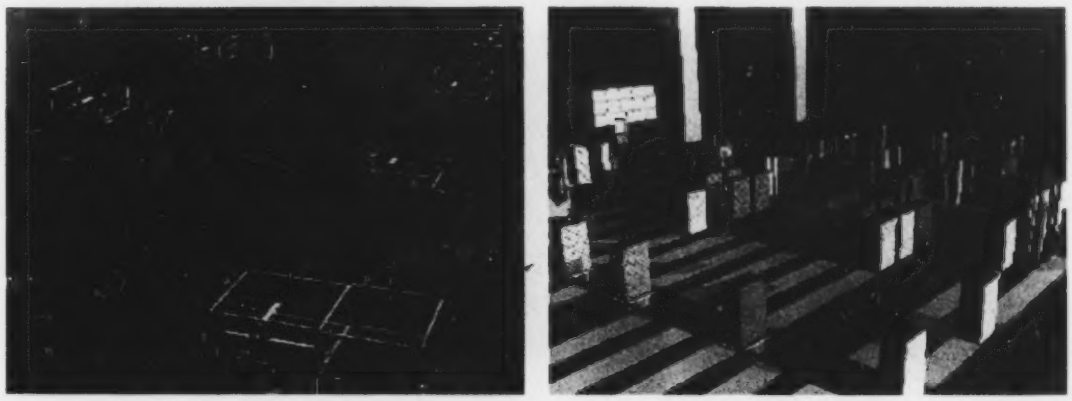

Figure 2: Visualization of Production and Logistics Scenarios

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4.2 VRML Authoring

The VRML **scene composing editor** provides the functionality of a general scene editor, and allows to build all kinds of VRML scenes regardless of the application context. The standard scene composing functionality is supported, such as to add new objects to the scene, to place objects, to group and ungroup objects and to define new objects. The scene composing editor uses a 3D graphical user interface, where the VRML objects can be directly manipulated. While building the scene, the user is monitored, and information on how objects have been grouped or joined is retained by the system. This information is used for animation computation.

The **structure editor** allows to modify the structure of the VRML scene, i.e. the hierarchy of VRML objects in the scene graph. The VRML structure editor provides both a 3D and a 2D graphical user interface, where the object hierarchy can be modified by drag and drop mechanism. The objects selected in the 2D view are also marked as selected in the 3D view of the scene. This has the advantage, that the user gets an immediate visual feedback of the selected VRML part.

The semantics of the scene graph hierarchy depends on the application, the user wishes to create. Imagine for example a scene that consists of different rooms or areas inside a building, such as a factory layout with different production areas. The user could thus decide to interpret a hierarchy level as a room or a production area. For an other application example imagine for instance a scene that consists of a highly complex 3D model, such as a motor or other machinery. In this case the user can decide to interpret a hierarchy level as a part group of the motor or of the machinery. The part hierarchy is used for the automated computation of explosion and disassembly animation.

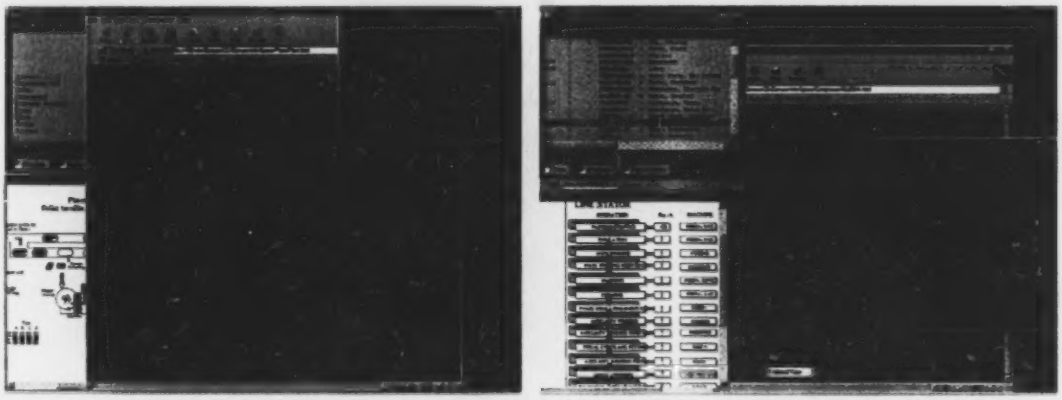

Figure 3: VRML Based Plant Manual, Drilling Machine Park and Product View

The **animation editor** offers support for the creation of general key frame animation. An explosion editor supports the automated generation of explosion animations. The automated generation of the explosion is based on the information tracked while the user has build the model. This includes information on the connectivity of parts and on surface normals. Based on this information an explosion animation is computed, that can be adjusted to the individual needs of an application.

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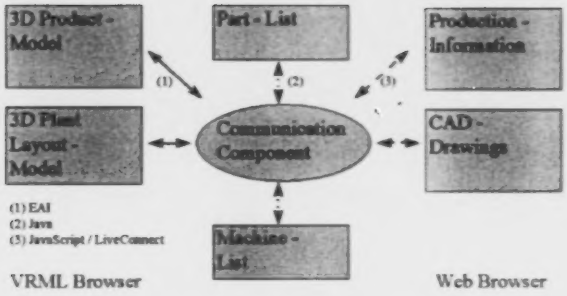

Figure 4: Overview of the Application Structure

4.3 Application Builder

The application building tool allows to embed the VRML application in a hypermedia context. The linking of parts of a VRML model to entries in an HTML based list or table is supported as well as the access to additional information. The examples depicted in [Figure 3] have been created with the tools described here and in the previous section. An overview of the technical structure of the applications described here is presented in [Figure 4]. The application builder consists of a relation editor, an annotation relation editor, and a composing editor.

The **relation editor** supports the definition of a relation between an object of the VRML file and an entry in a HTML page (table). When the default relation mode is applied, the relation editor will automatically create a relation for each object of the VRML file to a corresponding entry in the table on a sequential basis. The relation editor provides a 3D view of the VRML file, where objects can be connected to table entries by a double selection mechanism.

The **annotation relation editor** allows to define a set of information files to be related to both the VRML objects and the entries in a table or list. In the application depicted in [Figure 3], the additional information related to the parts in the VRML files consist in CAD drawings of the respective parts.

The **composition editor** composes the application, i.e. joins the relation information and the relation selectors (buttons) and creates an applet, and an embedding HTML page, from which the training application can be started.

The conjunction of both tools provides both automated support for the creation of 3D animation and automated support for integration in a hypermedia context.

5 Conclusion

In this paper we have shown how web-based technology using the Virtual Reality Modeling Language (VRML) can be applied in an industrial education and training context. Using VRML is not only a matter of providing technology but also of adapting technology to the specific application field. In the industrial application field automated VRML generation, cost-efficiency, industrial simulator linkage and integration in the established workflow are stressed. We presented examples of tools that show solutions how these application requirements can be met. As a result VRML in connection with the WWW opens new application fields of web technology in industrial companies.

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NETWORKED MULTIMEDIA AUTHORING WITH ILOG™ SOLVER

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Authoring and delivering networked multimedia is extremely complex process. The essence of multimedia authoring is that the author wants to communicate a message to the reader. In order to achieve this, the author uses an authoring tool to create the presentation schedule. Depending on the features of the authoring tool, the authors may be able to vary some presentation parameters such as font and size of text objects, spatial layout of graphical objects, and temporal parameters of continuous media objects. However, presentation delivery characteristics are impacted on by delivery environment including network bandwidth, latency and local disk storage, and the amount of multimedia data transmitted and invalidate the schedule. These varying characteristics are not addressed adequately in the authoring process. We propose a new approach to multimedia presentation scheduling thatutilises constraint technology and a flexible set of scheduling heuristics. The *Constraint Satisfaction AuthoringFramework* aims at increasing the expressive power of a multimedia authoring paradigm with regard to resource capacity conflicts and deals with domain uncertainty and incorporates it into the presentation schedule.

1 Introduction

Given the temporal specification of the playout of a collection of objects the correct results depend on multiple components: operating system, visual-audio subsystem, network facilities, and server database retrieval times. The presentation schedules created by any of the existing authoring tools are fixed predictive schedules with no regard to the varying performance of the multimedia delivery systems.

Although different types of reactive playout services have been suggested in several research projects (e.g.[Heiko and Klass 1996] and Papathomas, Blair, Coulson, Robin 1995]) they seem to pay limited attention to the generation of optimized presentation schedules and their seamless integration with media objects. In particular, the model of resources and types of resource constraints is typically simplified or non-existent.

The overall goal of *Constraint Satisfaction Authoring Framework (CSAF)* is to present a flexible, constraint based, authoring framework which can capture varying characteristics of delivery environments and deliver adjustable (elastic) multimedia presentation schedules. The heart of CSAF is the ILOG Constraint Solver™, which is used to generate presentation schedules.

2 Motivation and background

The objects involved in multimedia orchestrated presentations have typically very strict playout requirements. The violation of these requirements results in subsequent violation of temporal relations (temporal and precedence constraints) between the media objects. The current authoring paradigm does not encourage resource scheduling which would predict and minimize these violations in a way, which is highly independent of the underlying transport and highly transparent to the user. The scheduling services also should prevent the suboptimal utilization of shared resources and should encourage users to review their quality needs with regard to the cost of delivery.

2.1 Brief summary of current work

The examples of recent projects which incorporate synchronization specification and scheduling include: AthenaMuse [Hodges, and Sasnett 1993], Firefly [Buchanan and Zellweger 1993], HyTime/SGML [Buford and

Formulas and Figure 3 are missing from the copy received by ERIC.

Rutledge 1994], MHEG [Markey 1991], MADEand CMIFed [Hardman, Bulterman,and van Rossum 1994], and AMOS with its δ-sets [Heiko and Klass 1996]. Table 1 summarizes the features relevant to a resource scheduling process for the subset of case studies. The summary is based on the available reports in the literature and may be incomplete.

During the scheduling phase, these systems treat each 'active' resource separately (e.g. CPU, network bandwidth, etc.). Typically, only coarse-grained specifications are used to adjust the presentation parameters for each resource. They lack an integrated approach to optimal usage of resources using rich temporal specifications and strategies to stretch or shrink the activity playout duration.

Project/ property	HyTime	FireFly	AthenaMuse	MADE and CMIFed	δ-sets AMOS	MHEG
elastic activity duration	no	yes	no	yes	yes	limited
compile time scheduler	yes	yes	no	no	yes	no
real-time scheduler	limited	yes	no	yes	yes	yes
elastic end and start variables	no	yes	no	no	no	no
complexity of the search heuristics (none, simple, complex)	none	simple	none	none	simple	none
simple cost and benefit functions	no	yes	no	no	other cost scheme	no
resource usage conflict detection	no	yes	no	no	?	no
global resource constraints, capacity conflicts	no	no	?	no	limited	no
partial solutions supported	yes	yes	yes	yes	yes	?

Table 1 Summary of properties of scheduling entities in the selected case studies (? = not reported)

Only three of the surveyed systems [Blakowski, Hubel and Langreher 1992] [Buchanan and Zellweger 1993], [Heiko and Klass 1996] use a hybrid approach to resource management: a compile time scheduler to prepare presentation schedules in advance and then a run-time system which resolves fluctuations in media object behavior according to a fixed algorithm. None of these authoring frameworks provides support for consistent resource allocation specification with regard to user perceived quality and given capabilities of the resources. Optimization and constraint relaxation schemes are either non existent or too simple.

3 Constraint Satisfaction Authoring Framework

The architecture of our *Constraint Satisfaction Authoring Framework* relies on the following components: *Presentation composition editor, Predictive scheduler,* and *Sensory* module. The *Predictive Scheduler* is further decomposed into two cooperating modules: *Scheduling engine*, and *Synchronisation enforcement*. An overview of the architecture is in Figure 1.

The *Predictive scheduler* uses its *Scheduling engine* to create one or more consistent schedules which can be used for temporal management of the presentation and for the enforcement of synchronization among media objects. The dynamically varying internal constraints are represented by a set of quality classes (represented by a group of *Precision objects)* which contain information about *system internal constraints* and intercept via the sensory module possible changes in the multimedia system. The collection of *estimation methods* within the *Precision objects* allows the *Predictive Scheduler* to gather and statistically process the long term performance data and to apply appropriate statistical estimation methods to predict the behavior of the system.

The *Presentation composition editor* is the subsystem which interacts with the multimedia presentation author. The output is a coarse grained specification of spatial and temporal presentation layout. The author's quality and ordering requirements are communicated in the form of external constraints to the *Composer*. The *Composer's* role is to create composite media objects and associate their handles with the temporal layout requirements and communicate this information to the *Predictive scheduler.*

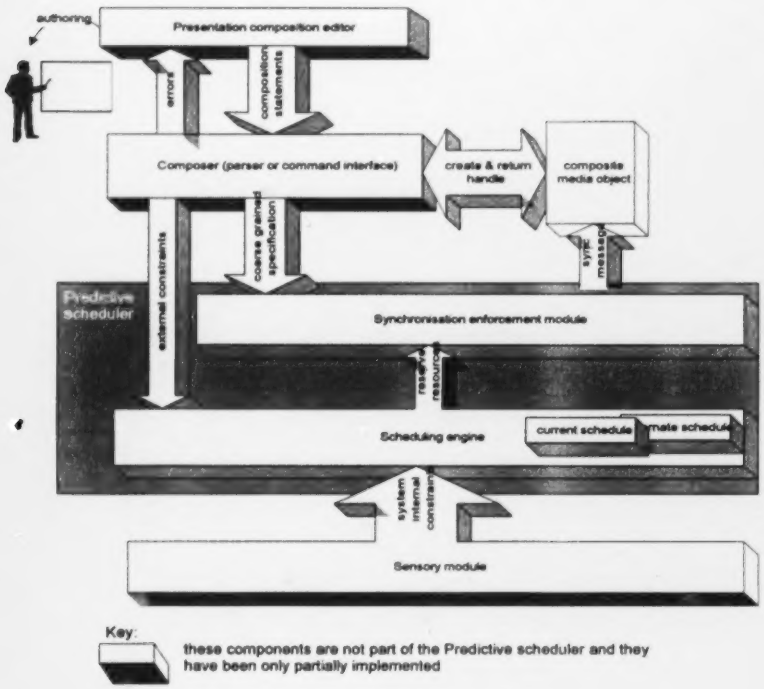

Figure 1. CSAF architecture

The *Sensory module* detects system internal constraints and provides feedback information regarding the needs of the presentation at run-time via *sensors* to the *Precision objects*. The *Precision objects* maintain knowledge about the environment, as indicated in the diagram.

3.2 Resource reservation model and schedule flexibility threshold

All the components of the resource reservation time are variables selected from the admissible time domains: t_1(start time domain), t_2(end time domain), t_3(duration domain), and t_4 (unexpected delays domain). An activity must reserve a resource for an extended duration T_{extij} as suggested below (Figure 2):

$$RESOURCE\_RESERVATION\_EXTENDED\_TIME$$

$$T_{extij} = ST_{ij}^{t1}(c) + ET_{ij}^{t2}(c) + d_{ij}^{t3}\left(c, \delta_{ij}^{t4}\right)$$

Each of the components of the activity duration is a function of the resource available capacity (denoted *c*). In addition, the activity duration depends on the size of unexpected delays (δ_{ij}^{t4}). The T_{extij} is an explicit entity that resides within the presentation schedule as a result of expected and unexpected events which impact on the actual duration for processing the activity. The upper and lower bounds of resource reservation time change dynamically whenever components of the resource reservation time change. This view is different from that taken by the majority of authoring tools in which the activity duration is modelled independently of the resource as a constant. This implies that the resource reservation time is also an indivisible constant.

The quality of a multimedia presentation is a function of the activity duration which in turn depends on the resource presentation parameters and processing constraints (external and system internal constraints). We assume that for each activity A_{ij} the average expected processing duration (*allowance*) d_{ij} is available and the required resource can initially be reserved for this duration. The resource can lack capacity or may have some left-over capacity, both of which will impact the presentation quality. In this context, we define a value - *Quality slack time* (see Eq 1: QST_{ij}) which represents the variations in presentation quality of the activity A_{ij} as

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a function of its *allowance*, earliest start time (EST_{ij}) and latest completion time (LCT_{ij}).

$$QST_{ij}(c) = LCT_{ij} - EST_{ij} - d_{ij} \qquad (1)$$

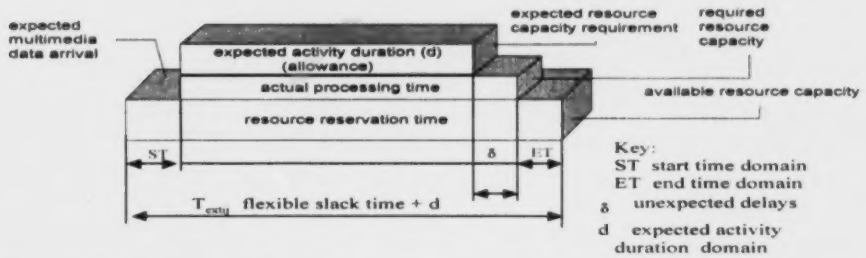

Figure 2. Resource reservation model

The $QST_{ij}(c)$ is an explicit entity within the scenario presentation schedule. It is composed of two portions: 1) predictable delays impacting the activity allowance which we termed *lower slack*, and 2) unpredictable delays impacting the activity allowance which we termed *upper slack*. Note that as the values EST_{ij} and LCT_{ij} are modified the value of $QST_{ij}(c)$ for the activity A_{ij} and possibly other activities will also change.

Resource capacity is a function of time as well as a function of *Quality slack time*. For simplicity, we assume that the resource capacity and the *Quality slack time* are directly proportional, and we compute the remaining capacity of the resource as: where RRC_{ij} is the resource's remaining capacity, RAC_{ij} is the resource's available capacity, RC_{ij} is the resource's required capacity. The *schedule flexibility threshold* is approximated as , where *TI* is the number of all non-overlapping time intervals in the schedule.

We have designed and implemented a scheduling approach that maintains flexibility in the form of a bounded *quality threshold* that is an explicit value in units of time maintained for each activity. The sum of over all non-overlapping time units (intervals) represents the *schedule flexibility threshold*. This means that as long as the temporal dimensions of the activity remain within the expected bounds and the schedule *makespan* is within the *schedule flexibility threshold* there is no need to reinforce synchronization constraints and generate a new schedule.

4.3 Scheduling process and elasticity strategies

The multimedia scheduling process is described as a Constraint Satisfaction Problem (*CSP*):

- a set of n variables $X = \{x_1,...x_n\}$ with values in the discrete finite domains $D_{x1},...D_{xn}$.
- a set of m constraints $C = \{c_1,...c_m\}$ where for i = 1,....,m.

The problem is to find an assignment such that

For each activity a variable is introduced. Furthermore, for each activity a domain of possible start times is specified where d_i is the activity *allowance* and at this point it is a constant integer value. The assignment corresponds to a schedule where and is the domain of all possible schedules which satisfy the given set of constraints. A solution to the *CSP* assigns a value to each variable from its respective domain that satisfies all constraints.

Three elasticity strategies have been implemented (Figure 3): The *activity elasticity* is determined by three properties: the minimum expected *allowance* - *T*, the *lower slack* time and *upper slack* time. The allowance is specified during a authoring process. The lower and upper slack time represent a measure of the known and unknown quality fluctuation. The quality fluctuation depends on the performance of

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the resource used or synchronization policy applied and may be different for different resources or policies. The activity allowance bounds are computed as solver preconditions.

The resource energy contention strategy is based on the amount of resource energy required to perform a given activity in the time interval and to meet the *quality threshold*. Let *commulative resource energy* be , the resource energy required by an activity for the activity duration be .

For each time interval , we can set a constrained condition

where are permissible domains for the activity allowance and the resource demand respectively. The size of both domains can be established from the system internal constraints, resource presentation parameters and constraints. The problem then consists of determining a suitable trade-off between the duration of the activity and utilization of the resource calculated as the cumulative resource energy reduced by the sum of all remaining resource energy requirements within this time interval (Equation 1).

(1)

Figure 3. Elasticity frameworks

To manage quality degradation we introduce the *quality threshold strategy*. We use the utility function, which is a measure of the user satisfaction with the allocation of the resource capacity. The user specifies the resource requirement in the terms of perceived benefits (benefit function) with regard to a resource presentation parameters and energy requirement e. The expected benefits are derived as the difference between the utility and the cost of the quality provided: , where is the expected user utility and is the cost of the resource reservation. The constraint solver then uses resource energy bounds and activity allowance to the actual resource presentation parameters.

5 Conclusion

CSAF incorporates uncertainty of the environment such as varying quality of resources, detects situations where the quality requested is not possible to maintain due to the environmental changes. We have enhanced the coarse grained synchronization specification supplied by the presentation script with the following constructs:

Activity elasticity strategy incorporates the system internal constraints in the form of a variety of the resource constraints. The activity is a variable which boundaries can be specified with regard to the systems internal constraints and the available resource capacity.

Energy contention strategy is based on finding a suitable trade-off between activity duration and its

demand for a resource.

Flexible quality threshold strategy is based on the observation that many multimedia applications are scaleable according to the utility function. Using this strategy, we can derive the expected benefit function and relate it to the cost of resource reservation and its presentation parameters.

CSAF framework showed good real-time performance to be used as a predictive scheduling mechanism.

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Enterpirse Learning Architecture

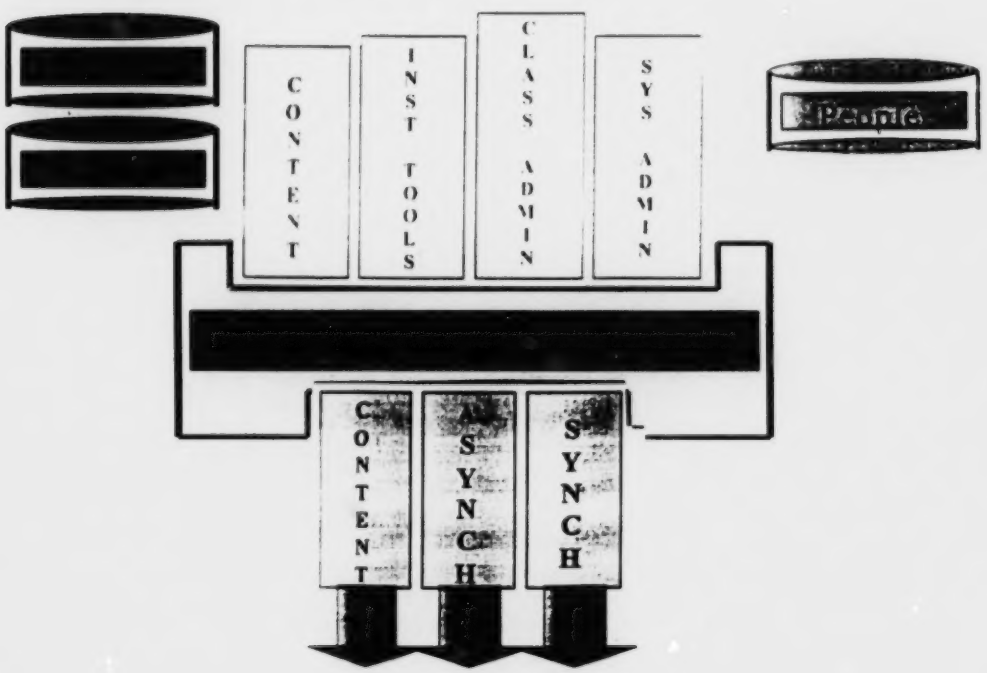
Author: Peter Duffey

Purpose

The purpose of the document is to outline a comprehensive architecture for a Learning Delivery System. Based on the architecture outlined, and the requirements to be addressed by the architecture, a number of specific capabilities are described. Each capability is matched with a specific skill set. Finally, the key elements for a successful architecture are described, as well as the danger to avoid for a successful deployment of learning architecture.

Architecture

The architecture of the Adaptive Learning Platform is outlined in the diagram below.



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The architecture comprises a content repository, a virtual classroom or learning server, a database, a number of tools that are used the server, and a variety of delivery mechanisms.

Architecture Components

Content Repository:

The content repository is a standard Web Server, holding a variety of content relevant to the course topics selected. This content will include:

-On-line, HTML version of the course Text
-Text graphics in .gif or JPEG format
-Teacher lesson plans and outline for course delivery
-Specific content used for async delivery
-Specific content used for synch delivery
-Any supplementary content
-Supplementary learning resources

Participant or People Database

The platform includes a relational database that holds are information on participants. Information includes course registrations, attendance, quiz scores, and other activities.

Virtual Classroom and Delivery Server

The learning server manages the "state" of the various learning groups and individuals access the server for learning situations. The server knows which people are in which class, which people have the hands up in the synchronous class, and all other associated data related to teaching and collaboration delivery. The server is able to deliver the content in both asynchronous, self-paced learning situations, on for live, virtual class interactions between students and instructors.

Content Views

The platform provides access and a variety of views into the content repository.

Instructional Tools

The uses a variety of instructional tools to add to the richness of learning experience. Some of these tools are; White Boards. Hand raise, Yes/No indications, audio between participants, threaded discussion, and more.

Participant management

The platform provides a variety of participant and course management tools. Some of these tools are; course building, course scheduling, course catalog, student registration, student home-pages, and more.

System Management

The platform provides a variety of system management tools. Some of the tools are; active pinging to report on participant connectivity, monitoring of server performance, logs of server errors or exceptions, and more.

Situational Learning Option

Most importantly, the platform provides support for three learning or content view options. The participants can

-use standards browsers to access and query the content repository. These activities can be for reviewing of the reference material, or for downloading of repository assests to be used at the participant discretion.

-asynchronous review, for self-paced study of the course flow and content.
-synchronous review, in a live, virtual classroom situation, of course flow, content and instructor facilitation.

Requirements Overview

At the highest level, the key requirements of an adaptive learning architecture are:

- Situational adaptability
- Scalability
- Robustness
- Manageability
- Support for a wide variety of content types
- Content repository for re-use
- Rich variety of learning and instruction tools
- Front-end capabilities for class scheduling, student registration, etc.
- Back-end capabilities for holding data on attendance, quiz scores, activities, etc.
- Reporting on student, instructor and class activity
- Reporting on learning platform use
- Support for Web standards for viewing Multimedia content.

Each requirement area is discussed in more depth.

Situational adaptability

The adaptive learning architecture will accommodate requirements for learning that are presented at various learning situations. For example,

- Publish the course outline for Before Class review
- Publish pre-class reading assignments for Before Class review
- Publish home work assignments for Before Class activity
- Provide a repository for home work submission
- Publish instructor review of home work
- Accommodate a full group virtual class experience
- Accommodate a number of sub-group virtual class experiences
- Accommodate the ad-hoc meeting or collaboration
- Maintain a view into the text or reference material for Before, During and After class
- Quizzing and testing for Before, During and After class
- After class ability to review what happened in the class, even if cases where a student missed the class
- After class group collaboration
- After class self study

Situation adaptability requires both the learning platform to be accommodating to the above requirements, and for learning implementers to incorporate a rich range of the above requirements into the learning experience they design and build.

Scalability:

The adaptive learning architecture must be accommodating to a range of class sizes and experiences. Of primary concern are;

- The highly collaborative class of 20-50 students, synchronously interacting with each other and the instructor

- The "executive all-hands update" broadcast of information to 250 participants. This group experience relies less on peer-to-peer collaboration and interaction
- The solitary, self-paced study situation, with hundreds of students doing individual study at one time.
- The sub-group or team oriented study experience.

Robustness

The adaptive learning platform must be robust in the face of many factors that combine to compromise the learning experience. Some of these factors are:

- A mix of participants with both fast and slower network connections
- Provide warning when slower connections become inadequate do to public Internet traffic.
- Support a variety of mix usages, including live, virtual classes, students in self-paced study and students accessing the class catalog and registration facilities.

Manageability

The adaptive learning platform should provide system administrators information as to the health and performance of the learning system. Some of the required information would be:

- Software performance monitor
- Network connectivity performance monitor and warning system
- A back-up system, with switch over capabilities
- Ability to move courses from one server to another and student registration groups from one system to another.
-

Support for a wide variety of content types

The adaptive learning architecture will support the widest possible variety of learning content types, including

- Any HTML content
- Any content viewable via a Plus-in
- Popular native content types, like PowerPoint
- CBT's
- Streaming video and audio
- Java and Java script applications
- Text on-line references
- Other reference material

Content repository for re-use

The adaptive learning architecture will support the re-use of content both from within the learning system, and for use outside the learning system. For example, either HTML or PowerPoint slides used for a synchronous class experience should be readily available for use in asynchronous experience, or for viewing in a simple browser. The content cannot be available only the adaptive learning platform. Therefore all content should be "housed" in a separate content repository that is easily assessable to outside users. This content repository is likely a standard Web server.

Rich variety of learning and instruction tools

The adaptive learning architecture will support a rich variety of learning tools and experiences. Some of these tools are;

- Gather customer information

Front-end capabilities

A number of delivery platform features are required to prepare content and participants for a variety of learning situations. Some of these features are listed below.

- Course builder, preparing a syllabus of materials and activities
- Course or meeting scheduler
- Catalogue for viewing scheduled courses
- Procedure to participants to register for a course from the catalogue
- A list of courses that a participant has registered for
- A way for participants to download any required class material or content

Back-end capabilities

Any activity on the delivery platform creates useful data. All data relating to participant registration, attendance, quiz scores, in class activities, homework submission, and grades assigned should be held in a database. The database should allow;

- easy input form other data sources
- flexible report building
- export of data to other data repositories

Reporting on learning participant activity

The back-end database will provide information for various reports on participant activity. Some of the reports required are;

- Active participant users in the database
- Accesses into the platform, and average time spent on activities
- Number of classes, and hours of synchronous instruction by instructors

Reporting on learning platform use

The database will also provide reports on the overall use of the learning platform. Some of the reports required are:

- Total student hours connected
-

Consistent and supportive of standards for multimedia viewing

The Adaptive Learning platform will support multimedia viewing and streaming standards, and particularly those standards supported by the World Wide Web. All viewing of content should be from a standard Web Browser. All streaming of content across the network should use standard Web protocols. Emerging Web standards, like Real Networks streaming video, should be supported.

Situational adaptability

Most importantly, the Adaptive Learning Platform should support a rich variety of learning situations. This will include:

- Before class, asynch review of the class outline, the scheduled meetings, the reading assignments, and any homework assignments
- Asynch review of class and associated materials
- Before class testing
- Before and after class threaded discussion
- In class synchronous facilitated class lead by an instructor, attended by up to 30 participants, and also attended by subject matter experts

- After class review of synchronous lecture and activities by students that happened to miss the live class
- After class team or small group meetings.

Features and Skill Sets

The features of the Adaptive Learning Platform require a number of features, and a equal number of skill sets by the individuals deploying the system.

Content Deployment

The range of content should be supported by the Adaptive Learning System. Some of the content types are listed below.

- Textbooks and reference material in HTML format.
- A syllabus of asynch course specific material, and a way to navigate through that material
- A syllabus of synch course specific material, and a way to navigate through that material
- Audio recording of synch class lecture and Q&A, for play-back by students that missed the class
- Video authoring
- CBT authoring
- Quiz authoring

In addition to content authoring, content deployment requires the skills of Web master. All content and syllabus navigation pages need to be stored in a Web Server repository. This content repository should be separate from the delivery platform, and should be able to provide a view of the content to a variety of collaborative interactions.

Technical Support

Deploying the Content Web Server repository and the Adaptive Learning Platform will require the skills of server and network administrator. This individual will need to skilled with NT Servers, and have knowledge of network connectivity and TCP/IP. Some of the technical support skills are:

- Set-up and configure an NT Server
- Set-up and configure a TCP/IP network, and have knowledge of firewalls and proxy servers.
- Trouble shoot server and network connectivity problems.

Instructional Design

Course subjects will be selected for delivery on the Adaptive Learning Platform. An instructional designer will need to outline the activities and flow of content that will comprise the course. This outline will include

- Asynch, self-paced study
- Synch class content and lecture outline

- Quizzes
- White board activities
- Breakout activities

Course Building

In addition to designing the flow of the course, and authoring the modules of content, an individual must package the content and flow into a complete course. This new skill typically requires some mix of web content authoring and instructional design.

Student and Course Management

The Adaptive Learning Platform will be used to provide instruction to thousands of participants. This will require significant activity involved with scheduling courses, registering students, and gathering post instruction data. This student/course management supervisor will need to be knowledgeable of databases, and importing and exporting data from one repository to another.

Instructor/Facilitator

New skills are required of the instructor/facilitator. Adaptive Leaning Platform instructor must have skills in the following areas;

- Sound knowledge of the Web.
- Good facilitator skills
- Knowledge of a multimedia PC
- Excellent verbal skills approaching that of a radio talk show host.

Project Management

One person is required to lead and direct a team with multiple members and multiple skills. A balance of skills is required to make any deployment of network-based learning successful. Of the above skills already mentioned, none of them are default candidates for this lead position. The project leader should be an individual that can balance the various skills and requirements, and guide the project to success.

Key Elements of Success

There are a number of areas that have proven to be critical for a successful deployment of a learning architecture. The key areas are:

- Web-centered delivery
- A delivery platform that provides for all the Before, During and After class activities
- A delivery platform that is will integrated and easy to use

Areas of Avoidance

Areas of deployment have been noticed to

- Excessive time and expense with content authoring
- Lack of delivery platform scalability
- Too much software installation required on participant machine

Developing Web-based Performance Support Systems to Encourage Lifelong Learning in the Workplace

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Abstract: Conventional training and electronic performance support system strategies which focus on meeting short-term performance requirements fail to prepare people to meet the ever-changing needs of today's complex workplace environment. Generative and intentional learning environments focus on the development of transferable, long-term, and higher-order skills that enable people to engage in lifelong learning activities. Influenced by generative and intentional learning environment strategies, a Web-based tool has been developed to empower people to build their own Web-based Performance Support Systems (WPSS) to support their learning, professional development, and performance in the workplace. Enabling people to develop their own WPSS accomplishes two goals: (1) people learn about the domain while they are locating, evaluating, and organizing resources to support their work activities and/or their lifelong learning activities; and (2) once the WPSS is completed it can be used to support performance and further professional development while working in that domain. In this way, the WPSS not only enables people to build a learning and performance resource that will provide them with immediate support and guidance, but also helps them develop structure, strategies, and skills for subsequent lifelong learning activities.

What do you do if...?

- Your company has just completely a major reorganization in which a number of number of positions — including yours — have been restructured and responsibilities reassigned. Now you are required to work on tasks you've not done before.
- You're a UNIX programmer for a company that has decided to replace its UNIX servers with PCs. Now, all new application development must be done for the PC platform.
- You've been a technical writer in your organization for three years. Now, in a move to reduce costs and build in quality assurance measures, instead of out-sourcing the desktop publishing of the documents and manuals you develop you will be required to "publish" the documents yourself.
- Your company has caught the World Wide Web bug and wants to implement a company-wide intranet. You've been assigned to convert the print-based Employee Handbook to an HTML document — by next Friday!

In a climate of rapid change, increasing innovation, emerging technologies, and proliferating knowledge, lifelong learning is a necessary professional development objective. In order to keep current, people have to be willing and able to continually "retool" their knowledge and skill base. simply knowing how to use tools and knowledge in a single domain at a specific point in time is not sufficient to remain productive and competitive. People must apply tools and knowledge to new domains and different situations. This is especially true given our current climate of rapid change, increasing innovation, and proliferating knowledge; people are having to face new domains and novel situations with increasing frequency due to the information explosion [Nash 1994]. The need to be a continuous learner is especially apparent in domains influenced by scientific and technological advances; these advances cause knowledge and skills to become obsolete overnight.

To deal with today's complex workplace environment, employers need personnel who possess contemporary skills and knowledge, and are willing and able to proactively update their abilities to meet the ever-changing needs of the organization. Employees who are able to keep up with the information explosion are valuable assets; employees who fail to "grow with the flow" are restructured out of their positions. Therefore, lifelong

learning is essential to staying current, competitive, productive, and innovative in today's workplace, and therefore employed and in-demand.

Following the prescriptions of the generative and intentional learning methodologies which promote the development of metacognitive and self-directed learning skills to support lifelong learning activities, a Web-based development tool was created. This tool was designed to help people in a workplace environment generate their own, individualized Web-based performance support systems (WPSS) to address the concerns described above by encouraging and providing a supportive structure for lifelong learning activities.

Lifelong Learning Defined

> Lifelong learning is any purposeful learning that an individual engages in throughout the life span...it is an activity engaged in...to gain greater individual self-fulfillment and to improve the quality of life for the individual and the emerging society. To achieve this requires moving away from a view of learning that is controlled outside the individual to a view of learning that is internally controlled by the individual. (Overly, McQuigg, Silvernail, & Coppedge, 1980)

The knowledge explosion requires professionals to engage in lifelong learning if they intend to stay current — let alone evolve, advance, and remain competitive — in their profession. Therefore, lifelong-learning skill development is imperative if people are expected to learn over the full expanse of their professional lives. Unfortunately, some of the people that most need lifelong learning skills — those with careers in ill-structured, complex professions — are not developing them during their formal education. Regarding the lack of lifelong-learning skill development in schools, Walton and Matthews [Walton & Matthews 1989] state, "Some [professionals] from…schools with the usual type of curriculum behave as if they had been immunized against further learning, and many [professionals] often do not continue to learn sufficiently." In order to better prepare for lifelong learning activities, learners must be exposed to learning activities that require them to take on and develop many of the responsibilities normally afforded to educators. "We teach most effectively when we help our students learn how to learn...not what to think and make and do in [the current year]; but how to think and how to learn for those years of life and profession than lie ahead" [Nash 1994]. To achieve this requires moving away from a view of learning that is controlled outside the individual — by a teacher, trainer, instructional designer, or subject matter expert — to a view of learning that is internally controlled by the individual [Overly et al. 1980]. Therefore, in order to internally control the learning process, the development, and subsequent successful application, of two skill areas -- metacognition and self-directedness – is required.

Metacognition

Von Wright [Von Wright 1992] defines metacognitive skills as "the steps that people take to regulate and modify the progress of their cognitive activity: to learn such skills is to acquire procedures which regulate cognitive processes." Glaser [Glaser 1984] describes metacognitive or self-regulatory skills as knowing what one knows and does not know, predicting outcomes, planning ahead, efficiently apportioning time and cognitive resources, and monitoring one's efforts to solve a problem or learn. More specifically, metacognitive skills that are required for lifelong learning include [Ridley, Schutz, Glanz, & Weinstein 1992]:

- the recognition of content and skill limitations;
- the ability to set goals and create action plans based on those defined limitations;
- the ability to activate the appropriate prior knowledge to achieve set goals;
- the ability to accurately assess progress in learning and task performance and effectiveness of learning resources selected;
- the awareness of what still needs to be completed to reach a set goal, and how best to allocate time and resources; and
- the ability to modify strategies, tactics, processes, and resource selection based on the needs of the task at hand.

Because metacognition involves these self-regulatory skills, it can have a positive impact on problem solving ability and the transfer of knowledge across domains and tasks if developed during instruction [Bereiter & Scardamalia 1985] [Bransford et al. 1986]. In fact, if not developed, students have difficulty recognizing when they have failed to adequately meet learning goals or complete tasks [Bransford et al. 1986]. Since these are skills utilized by successful practitioners and experts [Chi, Feltovich, & Glaser 1981] [Bransford et al. 1986], adequately developed metacognitive ability is needed in order to not only engage in effective problem solving and reasoning activities, but also lifelong learning.

Self-directedness

Self-directed learning is:

> ...the process in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing learning strategies, and evaluating learning outcomes [Knowles 1975].

The domain of medicine provides a perfect example of self-directedness. When dealing with real patients, the doctor has to begin assessing the patient's condition before having all of the data necessary to evaluate, diagnose, and treat the patient. Characteristically, the patient provides the doctor with fragments of information ("My stomach hurts. I can't hold any food down. No one else in my family is experiencing any problems."). The rest of the information needed to solve the patient's problem comes from the study of a variety of other resources: patient and family history, laboratory results, x-rays, other doctors' opinions, past experiences, similar cases in the case file, and current research findings on new diagnostic and treatment procedures. These skills are described as "self-directed learning skills" [Barrows 1985] [Barrows 1986].

Barrows [Barrows 1995] defines the process of self-directed learning as utilizing the following skills to solve a problem or fulfill a learning requirement:

- the ability to identify and define a problem/learning need;
- the ability to identify, find, use, and critique resources for solving the problem or meeting the learning requirement;
- the ability to capture and apply information from resources to the problem or learning need; and
- the ability to critique information, skills, and processes used to solve the problem or meet the learning requirement.

Staying abreast of new innovations, research, techniques, and information is a prerequisite for successful decision-making and problem-solving on-the-job. Therefore, professionals need to develop lifelong learning skills, specifically metacognitive and self-directed learning skills, if they intend to stay current in their fields.

Organizations and Professional Development

Although employees' ability to engage in lifelong learning has a direct impact on an organization's effectiveness in today's ever-changing marketplace, the development of the skills needed to engage in perpetual learning activities has been neglected by many employers. Unfortunately, many organizations rely on short-term solutions, such as conventional training and performance support tools.

The Conventional Training Solution

How are professional development activities typically addressed? We often see trainers imparting knowledge and procedures to trainees using canned, inflexible instructional materials which often do not reflect the true complexity of an ever-changing work environment. [Unfortunately, this is the case whether we are describing an instructor-led environment, computer-based training (CBT), or Web-based training (WBT) (which is often just CBT repurposed for the Web).] After the training activity is over, employees struggle with applying what

they learned from their training experience to the demands of their jobs. Not only did the conventional training solution not accurately represent the on-the-job performance requirements, but it did not prepare the employees to:

- transfer the knowledge and skills to their specific job requirements,
- extend the knowledge and skills presented during training to address increasingly complex job requirements, or
- update the knowledge and skills presented during training when their job requirements change or the knowledge and skills change.

In other words, what is missing from the equation is the development of domain-specific lifelong learning skills so those employees can actively transfer, extend, and update the knowledge and skills acquired during training. So, employers have looked for other professional development solutions that address this problem. One solution that has presented itself is electronic performance support systems (EPSS).

The Electronic Performance Support Systems Solution

Although redefined and revised over the last few years, the term *electronic performance support system* refers to an integrated database of information, tools, learning experiences, resources, and guidance/advise designed to help people learn how to perform a task just-in-time or on-demand with limited conventional training support [Gery 1991] [Raybould 1995]. Addressing the failings of conventional training, electronic performance support systems have been utilized as alternatives and supplements for conventional training solutions.

However, the problem with conventional training is also, in part, the problem with EPSS. EPSS products are typically developed by instructional designers or performance technologists working with content experts. All of the tools, references, job aids, and tutorials are created to meet the generic needs of all the individuals who will access the EPSS. EPSS limits individualization because it assumes that everyone who needs to access the EPSS has the same performance issues, learning needs, and learning preferences. In addition, like with conventional training solutions, all of the higher-order thinking, problem-solving, and decision-making that goes into creating the "content" of an EPSS — all of the activity that helps people develop domain-specific lifelong learning skills — is done by the development team. So, again, the issues of transfer, extension, and updating are not effectively addressed by EPSS.

So, how do we develop lifelong learning skills?

In order to develop lifelong learning skills, the learners — as opposed to the instructor or development team — need to be directing and driving the learning process and activities based on their learning and performance needs. Two instructional methodologies that specifically address the development of lifelong learning skills are generative learning and intentional learning.

Generative Learning Environments

Generative learning environments require students — individually and collaboratively — to be responsible for creating, elaborating, and representing domain knowledge in an organized manner [Cognition and Technology Group at Vanderbilt 1992] [Hannafin 1992] [Scardamalia et al. 1989] [Scardamalia & Bereiter 1991]. Through a this process of "generating" knowledge, instead of passively receiving information, learners develop structure, strategies, and habit for lifelong learning.

Generative learning environments require students to take responsibility for determining what it is about a particular domain they need to know, and then direct their activities accordingly to effectively research, synthesize, and present their findings. Schank and Jona [Shank & Jona 1991] describe a generative learning environment in their discussion on the research method of teaching. Under the research method of teaching, students are asked to research a particular topic and then present their results to others (the class, a collaborative

group, etc.). In this way, students are taking over the responsibility of information gathering and synthesis and dissemination/presentation from the teacher. For this teaching method to lead to successful learning, students need to be allowed to select their own topics to research and report on, so that they have a real interest in proceeding with the assignment and have more control over their learning. Because the learning is student-directed, where each student makes choices and takes responsibility for those choices, the learning is more meaningful; "...in general, material that is organized in terms of a person's own interests and cognitive structures is material that has the best chance of being accessible in memory" [Bruner 1961]. In addition, because students are responsible for selecting a topic, developing a question to research, making decisions about how to gather information, analyzing and synthesizing information, etc., they are engaging in activities that help to develop high-level thinking and problem solving abilities.

In a generative learning environment, content and skills are learned within a context that is similar to the context in which the knowledge will be applied and performance is scaffolded by a social structure that supports them during learning and problem-solving activities. Contextualization of learning and social support during learning help prepare people to transfer what they have learned to new situations and avoid the pitfalls of inert knowledge. Generative learning environments involve learners in a particular set of instructional strategies and tactics to have the desired cognitive effects on learning:

- Learner responsibility. Using self-directed learning activities, learners are encouraged to be responsible for their own learning.
- Dynamic, active learning. Learning is essentially an act of active construction on the part of the student [Resnick 1989]. By requiring learners to take on the roles of the profession and engage in self-directed learning, learners experience the knowledge construction process.
- Authentic learning. Because learning is embedded in realistic contexts, learners acquire content and skills through the resolution of problems. Because the problems learners work on refer to concrete situations or events in the real world, knowledge gain is situated and, therefore, more easily retrieved when needed [Brown et al. 1989].
- Collaboration. Through collaborative group work and the accessing of a variety of resources, learners experience and develop an appreciation for multiple perspectives.
- Reflection. One of the key educational outcomes of generative learning environments is knowing how we know: the ability to (1) analyze personal knowledge construction processes and (2) articulate why and how a learning task was completed or a problem was solved [Honebein 1996]. This self-awareness of the knowledge construction process is encouraged during reflection activities embedded in the problem-solving process.

Intentional Learning Environments

Intentional learning refers to the "cognitive processes that have learning as a goal rather than an incidental outcome" [Bereiter & Scardamalia 1989]. Intentional learning encourages students to take "an intentional stance toward cognition" [Scardamalia & Bereiter 1991], which means that learners must learn how to monitor and be aware of their own learning processes, and take responsibility for pursuing desired and/or required learning outcomes. Intentional learning is learning that is actively pursued by and controlled by the learner [Resnick 1989]. Palincsar and Klenk [Palincsar & Klenk 1992] describe intentional learning as an achievement resulting from the learner's purposeful, effortful, self-regulated, and active engagement. By encouraging students to take "an intentional stance toward cognition", intentional learning helps students learn how to not only monitor and be aware of their own thinking and learning processes (i.e., metacognitive skills), but also to take responsibility for pursuing individually-determined learning goals (i.e., self-directed learning) — the "cognitive processes that have learning as a goal rather than an incidental outcome" [Bereiter & Scardamalia 1989].

The objective of an intentional learning environment is to create a supportive structure in which students can engage in cooperative knowledge building as they move towards greater autonomy. Addressing students' need for higher-order abilities in thinking and learning, intentional learning helps students develop the general metacognitive and self-directed learning skills that facilitate autonomous lifelong learning [Palincsar 1990] [Scardamalia et al. 1989]. These skills are developed by engaging students in situations in which they need to

build a body of knowledge based on their learning interests and needs using a variety of information resources. While building the knowledge base, students practice tactics for making claims, collecting evidence in support of their claims, and evaluating and responding to counterarguments from peers and teachers. Through this knowledge-building process, students reflect on specific aspects of their learning and thinking processes, and consider the effects of collaboration on each other's learning, such as the impact of opinion, bias, controversy, debate, and negotiation [Glaser 1991].

An example of a computer-mediated, intentional learning environment is the Computer-Supported Intentional learning Environment (CSILE). The goal of CSILE is to support students in the purposeful, intentional processing of information [Scardamalia et al. 1989] [Scardamalia & Bereiter 1991]. Using CSILE, students are supported in the construction of a shared knowledge base, representing and organized the domain in ways that can be understood and utilized by others interested in the domain. In other words, instead of accessing information from a pre-existing database that was structured, organized, and filled in by someone else, students engaged in CSILE create their own knowledge base based on what they want to learn and on how they want to structure and organize the information to be an effective resource for other learners.

Generative and intentional learning environments encourage students to construct their own meaning, perception, understanding, and knowledge. Through the process of creating, elaborating, and representing their own knowledge, these learning environments utilize instructional strategies such as collaboration, knowledge construction, reflection, and self-directedness to promote the development of lifelong learning skills and strategies, as well as a predisposition to lifelong learning activities.

Throw them all together and what do you get?: Web-based Performance Support Systems (WPSS)

Influenced by generative and intentional learning methodologies as well as the EPSS technology, I have developed a Web-based tool empowers learners to build their own Web-based Performance Support Systems (WPSS) to support their learning, professional development, and performance within specific domains. Similar to electronic performance support systems (EPSS), a WPSS uses the Web to provide on-demand access to integrated information, guidance, advice, assistance, training, and tools to enable high-level job performance. In fact, using the Web to create performance support systems is a perfect fit because the Web is actively used by professionals as a forum for the distribution of current and up-to-date references, instruction, and guidance.

By creating a structure that supports individualized and collaborative knowledge building by the people who will actually be using the knowledge, the higher-order thinking, problem-solving, and decision-making regarding the selection and utilization of appropriate learning materials and performance support is done by those who can get the most out of the process. In addition, because these activities occur in the workplace and are driven by the needs of the job at hand, the learning activities are contextualized, authentic, and meaningful. Enabling people to utilize an easy-to-use tool to develop their own WPSS accomplishes two goals:

1. they learn about the domain while they are locating, evaluating (which requires utilization of resources), and organizing resources to support their job performance activities and/or their generative and intentional learning activities; and
2. once the WPSS is completed it can be used to support performance and further professional development while working in that domain.

In this way, the WPSS not only enables learners to build a learning and performance resource that will provide them with immediate support and guidance, but also helps them develop structure, strategies, and skills for subsequent lifelong learning activities.

Overview of WPSS Development Tool Components

The WPSS development tool helps employees — collaboratively and as individuals — organize, assess, and utilize Web-based resources. In order to build an effective WPSS, the development tool enables people to organize Web resources into a variety of self-determined categories. Categories may include:

- cue cards: brief definitions, reminders, directives, job aids, best practices
- computer-based instruction: tutorials, case studies, practice activities
- wizards: intelligent demonstration/application functions; assistance
- coaches: response sensitive correction and feedback
- mentors: individualized responses to questions from experts in the field
- practitioner forum: access to other practitioners in the field
- examples
- tools

In order to build a WPSS that meet individualize, specific learning and job performance needs, people engage in a number of generative and intentional learning activities including:

- determining their learning needs and goals
- developing a plan for action for finding resources to help fulfill those goals
- researching Web resources that meet the appropriate needs
- utilizing Web resources in order to evaluate usefulness, difficulty level, strengths and
- weaknesses
- updating links to Web resources when appropriate
- responding to other learners' comments regarding WPSS contributions
- developing Web resources via HTML pages and threaded discussion forums

In other words, employees practice and develop the very skills and strategies needed to engage in lifelong learning activities while they are learning domain-specific content and skills needed for their jobs.

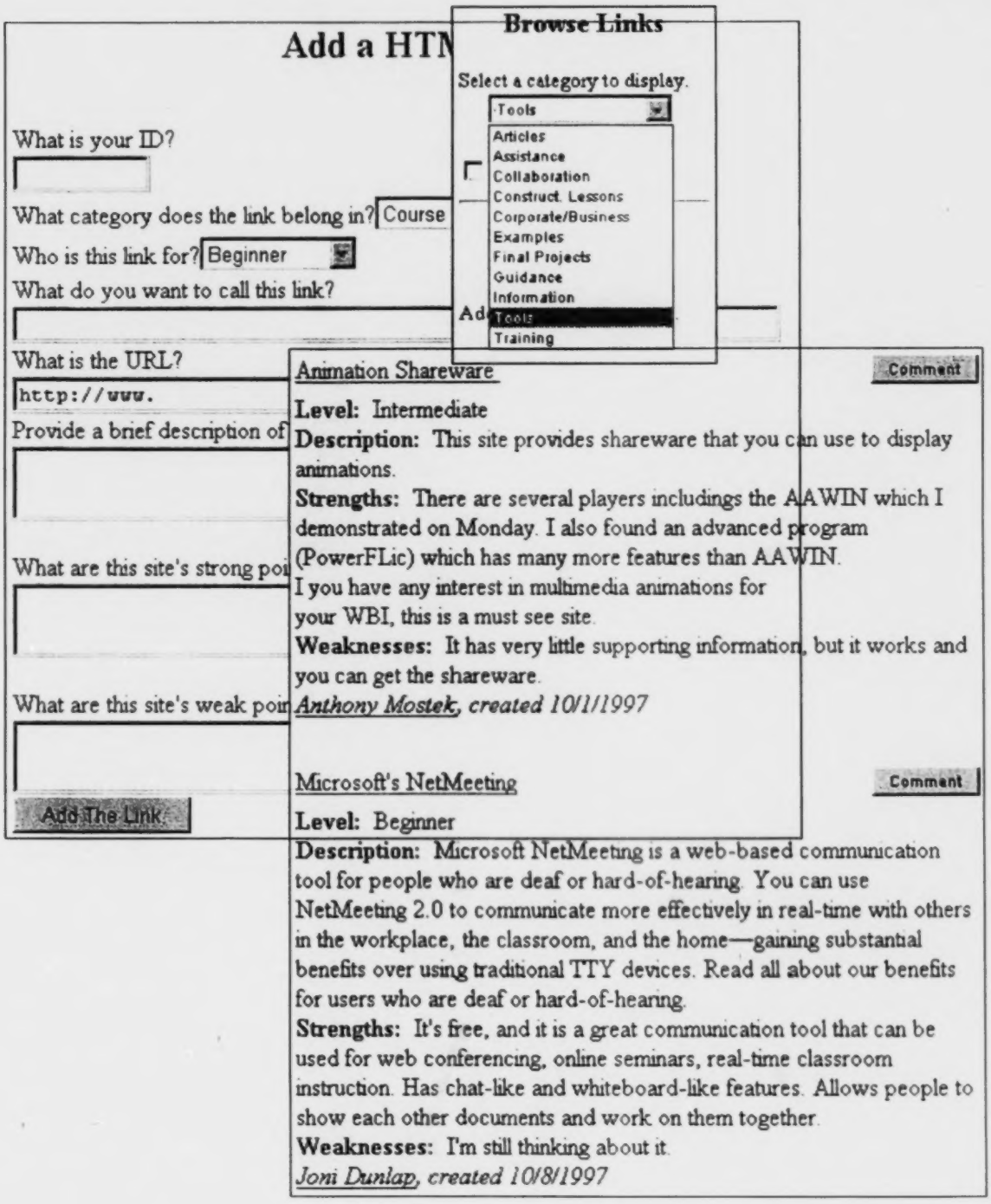
Add a HTM
What is your ID?
What category does the link belong in? Course
Who is this link for? Beginner
What do you want to call this link?
What is the URL?
http://www.
Provide a brief description of
What are this site's strong poi
What are this site's weak poi
Add The Link
Browse Links
Select a category to display.
Tools
Articles
Assistance
Collaboration
Construct. Lessons
Corporate/Business
Examples
Final Projects
Guidance
Information
Tools
Training
Animation Shareware
Comment
Level: Intermediate
Description: This site provides shareware that you can use to display animations.
Strengths: There are several players includings the AAWIN which I demonstrated on Monday. I also found an advanced program (PowerFLic) which has many more features than AAWIN.
I you have any interest in multimedia animations for your WBI, this is a must see site.
Weaknesses: It has very little supporting information, but it works and you can get the shareware.
Anthony Mostek, created 10/1/1997
Microsoft's NetMeeting
Comment
Level: Beginner
Description: Microsoft NetMeeting is a web-based communication tool for people who are deaf or hard-of-hearing. You can use NetMeeting 2.0 to communicate more effectively in real-time with others in the workplace, the classroom, and the home—gaining substantial benefits over using traditional TTY devices. Read all about our benefits for users who are deaf or hard-of-hearing.
Strengths: It's free, and it is a great communication tool that can be used for web conferencing, online seminars, real-time classroom instruction. Has chat-like and whiteboard-like features. Allows people to show each other documents and work on them together.
Weaknesses: I'm still thinking about it.
Joni Dunlap, created 10/8/1997

Figure 1: Sample categories, corresponding reflective entries, and "add a resource" screen

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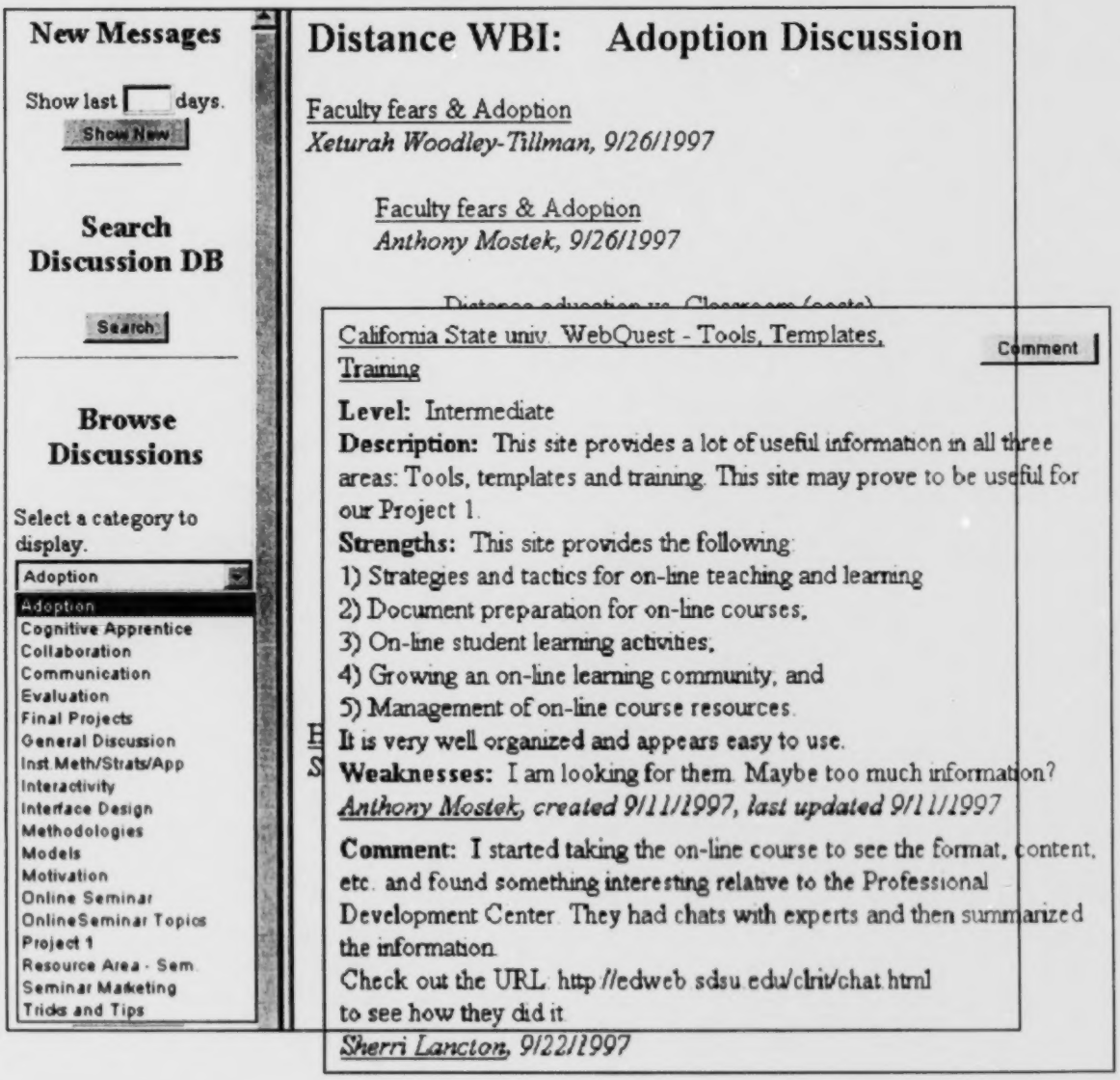
New Messages
Show last days.
Show New
Search Discussion DB
Search
Browse Discussions
Select a category to display.
Adoption
Adoption
Cognitive Apprentice
Collaboration
Communication
Evaluation
Final Projects
General Discussion
Inst Meth/Strats/App
Interactivity
Interface Design
Methodologies
Models
Motivation
Online Seminar
OnlineSeminar Topics
Project 1
Resource Area - Sem
Seminar Marketing
Tricks and Tips
Distance WBI: Adoption Discussion
Faculty fears & Adoption
Xeturah Woodley-Tillman, 9/26/1997
Faculty fears & Adoption
Anthony Mostek, 9/26/1997
California State univ. WebQuest - Tools, Templates, Training
Comment
Level: Intermediate
Description: This site provides a lot of useful information in all three areas: Tools, templates and training. This site may prove to be useful for our Project 1.
Strengths: This site provides the following:
1) Strategies and tactics for on-line teaching and learning
2) Document preparation for on-line courses,
3) On-line student learning activities,
4) Growing an on-line learning community, and
5) Management of on-line course resources.
It is very well organized and appears easy to use.
Weaknesses: I am looking for them. Maybe too much information?
Anthony Mostek, created 9/11/1997, last updated 9/11/1997
Comment: I started taking the on-line course to see the format, content, etc. and found something interesting relative to the Professional Development Center. They had chats with experts and then summarized the information.
Check out the URL: http://edweb.sdsu.edu/clrit/chat.html to see how they did it.
Sherri Lancton, 9/22/1997

Figure 2: Example of advice and guidance features, collaborative knowledge construction

Examples of the WPSS in Use

Although still in a formative stage with enhancements being added all the time, there are a number of examples of the WPSS tool in action. These WPSS examples can be viewed for examination purposes only via the following URL:

http://www.cudenver.edu/~jdunlap

[Note: In order for the WPSS to function properly, your browser must accept cookies and have JavaScript enabled.]

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Conclusion

Because of the failure of conventional training and performance support environments to meet the perpetually changing needs of today's working professionals, the application of generative learning and intentional learning strategies are vital to promote the development of the lifelong learning skills and strategies needed to stay current and remain competitive and innovative. A Web-based development tool was designed to enable people to develop their own Web-based performance support systems. The activity of building a WPSS helps people learn about a domain, construct a knowledge base to support their future performance and professional development in that domain, and develop the skills, strategies, and structure needed to engage in the type of lifelong learning activities that will help them stay current in their professions.

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The 3Ls of Introductory Web-based Instructional Design: Linking, Layout, and Learner Support

Abstract: If you are just starting to develop Web-based instruction, you may be wondering how to make decisions regarding the overall look-and-feel of your Web site. If this is the case, then understanding how the 3Ls — linking, layout, and learner support — of Web-based instructional design can help you develop an effective structure for your instructional products. Consistent with the hypermedia learning environment design guidelines provided by Kommers, Grabinger, and Dunlap [Kommers et al. 1996], the following WBI design guidelines will provide some guidance for laying the foundation for your WBI environments.

If you are just starting to develop Web-based instruction (WBI), you may be wondering how to make decisions regarding the overall look-and-feel of your Web site. If this is the case, then understanding how the 3Ls -- linking, layout, and learner support -- of Web-based instructional design can help you develop an effective structure for your instructional products. The guidelines -- or heuristics -- presented in the paper will give you a foundation for doing basic Web page design; in fact, I provide these guidelines to my students in introductory HTML courses to give them a starting point. The basis for these guidelines are four chapters cover topics related to the design of hypermedia learning environments [Kommers et al. 1996]; I revisited and adjusted the hypermedia design guidelines to better reflect design requirements of Web environment. Although not empirically based, the following WBI design guidelines (presented more as a job aid or performance support tool) will provide you will a practical way to begin thinking about WBI design as you begin developing your own WBI environments.

Nodes and Links: Macro Level Design

Nodes and links are the basic building blocks of Web and other hypermedia systems -- they are what allows learners to maneuver through a Web site or move from one Web site to another with the click of a mouse button; the node/link mechanism is what makes the Web a hypermedia technology. Nodes are information units within a Web site. Links are the way these information units are physically and conceptually connected and interrelated. Web designers use the depth and breadth of content coverage to determine the links and nodes needed to meet the learning and information dissemination objectives of the Web site.

More About Nodes

How Nodes Work

Web nodes may be accessed, if supported with the appropriate links, in any sequence that meets the learning and/or information needs and interests of the learners. Rather than coming across as a continuous linear flow of information, such as that found in books or videotapes, Web sites chunk information into nodes and establish connections between the different nodes. This is referred to as modularizing the information on a Web site. Modularization enables users of Web-based instruction (WBI) to determine for themselves which node to access next. It may be that a node consists of an elaboration, an opposing point of view, an example, or an illustration. In a typical Web-based application, learners navigate through the program via links because they want to get from one segment of information to another—one node leads to another. For example, one learner engaged in a Web site covering English history may go to a node on the reign of King James I and see a reference to the works of William Shakespeare. This reference may encourage the student to proceed to a node that provides information on the works of William Shakespeare. Another learner viewing the same node on King James I may be intrigued by a reference to Mary, Queen of Scots and choose to access that node instead. Therefore, by modularizing the information in a Web site, learners are able to access information more efficiently. This kind of flexibility provides learners with opportunities to explore a wider variety of information on the topics that they are studying.

Determining Nodes

Determining the nodes needed for your Web-based instructional site begins with defining and focusing on your content area. To determine what will be included in the WBI, you must:

- determine the purpose of your WBI (based on learning objectives, audience, outcomes, etc.);
- decide how much information will be covered and how it needs to be covered to meet the learning objectives; and
- in the case of an problem-based application, you may need to determine the information necessary for the learners to solve a problem or to participate in a simulation.

After you determine what should be included in the Web site for it to meet the objectives, then comes the tricky part of determining how to organize that information into coherent, modularized, easy-to-digest pieces. This is no easy task, considering that most Web sites rely on an abundance of information in order to fulfill the information and/or learning needs or interests of the target audience. But how do you decide how the information should be chunked?

Node Size

The easiest way to think about nodes when trying to determine size is to think of them as separate pages or screens, each containing one idea or concept. Nevertheless, the size of a node raises interesting problems in a Web environment. A book gives learners direct physical reference cues to its size and to the location of information relative to the rest of the information in the book— visual and touch comparisons are easily made. On the Web, however, the next node always replaces the previous node. The "next" node may be from an earlier or later part of the WBI. It may or may not be in direct sequence. The physical anchors so important in the print medium (i.e., thickness of the book, position within a chapter, number of pages) disappear and so does our ability to make comparisons and keep track of where we are at any given point. It is also important to remember that people do not care to read a great deal of text from computer screens, so information must appear manageable and brief.

Presentation Format

Within each node type, the format of the information can vary significantly, depending on the best way to represent that information. In fact, many different forms may make up one node: text, graphics, animation, video, or audio.

More About Links

Characteristics of Links

Web-based applications connect nodes of information through links – one node is connected to other nodes via links Links are the essence of Web-based applications. A well-designed set of links reveals information and helps learners attain their objectives. A poorly designed set of links misinforms learners or inadvertently hides things from them.

On the Web, links are typically represented in two ways: different colored text or an imagemap (i.e., a hyper graphic or photograph that engages a link). Learners know that a link is available when they pass their mouse cursor over the colored text or imagemap and the cursor changes from an I-beam to a pointer or from a pointer to a finger-pointing hand. In addition, Web links usually use a visual cue to indicate the activation of a link, such as

changing color. For example, the current color convention for text-based links is to use blue to indicate which text is an
active/available link, red to indicate that you have successfully clicked on an active link, and purple to indicate a previously visited link.

Kinds of Links: Contextual Links

Contextual links join various parts of a Web-based instructional system to enable learners to find the information they need. There are two types of contextual links: sequential and relational.

Sequential Links. Sequential links create a linear path among a set of related nodes. A set of sequential links is a predetermined path through a Web site that directs learners to either go to the next node or the previous node. They are most easily represented by the ever-present left and right arrows. The caveat associated with sequential links is that you may direct learners to go linearly through a series of nodes, but they don't have to due to the hyper nature of the Web.

Some Web sites provide default routes through the site represented by clickable arrows or table of contents. Learners who do not wish to make their own way through a Web site may elect to use a path defined by the site's designer. A linear path is especially useful when a learner should view each node in a particular sequence in order to better understand the content.

Relational Links. Relational links enable learners to pursue information tied together by common elements, although not in a sequential manner. There are three main kinds of relational links: associative, elaborative, and hierarchical.

Associative Links. An associative link searches for information related to (or associated with) a specific node, word, or phrase. A set of associations creates a web or network of different kinds of related information that can be accessed from multiple points within the Web site. Associative relationships are often defined more by the needs of the learners than by the content. They permit learners to jump across different nodes and Web pages to find information pertinent to their needs and interests. Associative links are significant parts of most WBI systems because they provide access to information in ways that were not planned by the designer. The goal behind the creation of associative links is to emulate the way people think. We do not think or process information in
a linear manner; instead, we take in information simultaneously from a variety of inputs. The concept of hypermedia environments was developed to allow users to follow their own associations. It is these kinds of links, that if well-designed, provide learners access to all the information in a Web-based learning environment. Associations can be created by using keyword searches or by setting up links based on a variable setting which represents a learner's actions. The primary advantage of associative links is flexibility: the more flexible the links, the more powerful the system. Associative links provide a means of individualization—a way of making information more personally meaningful.

Elaborative Links. Although the relationship between two associated nodes may be defined either by context or by learner goal, the relationship between two elaborative nodes is context dependent. An elaborative link is a special kind of sequential link that provides more complex and more detailed information on a specific topic. An elaborative series of links differs from a sequential series of links because learners are free to decide whether or not to enter the elaborative series and, once the series is entered, how deep to go.

Hierarchical Links. A hierarchical structure links information in a progressive manner, illustrating rank or level of importance. Hierarchical links provide a good overall organizing structure for Web-based environments that deal with several levels of classifications, such as diagnosis within a class of diseases, explanation of genus in biology, or description of an organizational structure. They differ from elaborative links in that the path down through the

hierarchy is not usually optional: For learners to understand the hierarchy, they must continue along the complete path. Therefore, hierarchical links are highly structured, leading learners through a logical path with a predetermined end.

Nodes	1	Where possible, modularize information on each Web page in the site so that each node fits easily on one screen or window.
	2	Label sections of the Web page to describe the kinds of information they contain.
	3	If possible, avoid forcing learners to scroll through screen after screen of text. Exception: lists (like a glossary) and indexes.
	4	Use different backgrounds to distinguish among different node media formats.
	5	If resources are available, use the node form that most appropriately represents the information contained in the node.
General Links	1	Avoid the "click here" syndrome. For example, when you want people to know that your name is a link for sending you email, make your name the actual link.
	2	Avoid too many text-based links in a paragraph of text. Too many links can distract from the overall message trying to be conveyed.
Sequential Links	1	Use arrows when the option of proceeding through a hypertext in a sequential path is necessary. When it is appropriate to design a sequential path through a hypertext (e.g., presenting chronologies or logical step-by-step processes), providing users with left and right arrow keys informs them that they are proceeding through the information in a sequential fashion. (Note: The use of left/right arrows may be culturally bound. Societies that read from top to bottom may be more comfortable with up/down arrows.)
	2	When using left/right arrows to proceed through several pages of information related to one idea, remove the left arrow from the first page/screen and the right arrow from the last page/screen.
	3	In a multiple section or page sequence, use the section or page x of y strategy to tell learners how many pages are in the sequence and where they are in the sequence.
Associative Links	1	To remind learners of where they are within a Web site, provide extensive verbal/textual support. Web pages should always include headings to indicate what the topic of the page is and to which section it belongs. Extensive use of menu and content lists are also helpful.
	2	Where there is a sequence representing critical information, build the sequence into the associations so the user does not miss part of the sequence. In other words, use sequential strategies.
Elaborative Links	1	Use elaborative links to present information in a progressively deeper manner (or in a progressively less detailed manner).
	2	Make learners aware of the depth to which a sequence ofelaborations goes (e.g., "level 1 of 5").
Hierarchical Links	1	Hierarchies are highly structured. Keep users aware of that structure with verbal and graphic support.
	2	Use up/down arrows to indicate the path through a hierarchy. Indicate which level of the hierarchy a learner has entered (e.g., "level 1 of 5").

Figure 1. Design Guidelines for Nodes and Links

Page/Screen Design Issues for Web Sites: Micro Level Design

The objective of effective WBI is to communicate information and ideas to a specific audience. Thus, a Web site requires more design consideration regarding the display of text and graphics on a page than a work of fiction such as a novel or short story. Novels maintain reader involvement with literary devices such as plot, story, characterization, theme, and dialogue. In WBI, learner involvement through literary devices is not always possible or desirable. While fiction gets by quite well with page after page of one word beside another, WBI uses more than words. Web-based instructional programs are for learning, and require different techniques to maintain learner involvement and encourage cognitive processing of content.

As you probably have already noticed, Web-based instructional applications tend to rely heavily on the written word to present information. Even Web sites using a large number of sophisticated graphics and animation combine those graphic forms with written words. All of this information is presented by combining text elements, images, and graphic devices (e.g., lines, shading, boxes) in an empty space to present information. The combination and arrangement of text and graphical elements in meaningful ways are problems of message design and layout.

Some of the Web page design elements which require consideration include:

type size, style, weight	contrast	header, body, footer	animation
word spacing	foreground color	tables, frames	special effects
leading, kerning	background color	fields, forms	graphic resolution
rules	background texture	buttons, icons, imagemaps	text-to-graphic balance
headings	letter color	pop-up windows, alerts	shading

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However, none of these elements matter unless they are organized and displayed to promote legibility.

Legibility

Techniques used to facilitate learner involvement with WBI fall within the domain of legibility. Legibility is the influence of the total format of the display on the ability of the learner to understand the text. The words "total format" are emphasized because we often tend to think of legible text as that which can be seen. However, visibility is only one part of legibility. Legible text possesses two primary design qualities which designers must work to enhance: visibility and recognizability. You have to work, to some extent, with these three qualities to facilitate retention of information by encouraging deeper learner involvement.

Visibility

Visibility refers to the perceptual detectability and discriminability of the printed character. Visibility includes characteristics related to the clarity of the image, crispness of type, and contrast between foreground and background. A visible display presents symbols clearly and accurately. Visibility variables interact with the eyesight of the reader, as well as with conditions external to the reader such as lighting. For example, a Web page with poor contrast between letters and background fails the visibility test of legibility, because without adequate contrast the shapes of the letters would stand out from the background. Another important factor in visibility is the size of the text. Letters that are too small may not be perceived for what they are. Visibility is a prerequisite for recognizability, for without adequate visibility the learner fails to recognize the meaning of individual symbols on the Web page.

Recognizability

Recognizability refers to the ability of a Web page to convey the meaning of letters, words, and objects. A recognizable Web page presents meaningful symbols so the meaning of each symbol can be identified and understood. Recognizability interacts with both text elements and reader characteristics—the background or prior knowledge of the reader. For example, a first grader may be able to recognize each of the letters on this page, but would have difficulty recognizing the meanings of all of the word symbols on this page, even though they are quite visible. Additionally, a screen display in Russian may be quite visible, but it would not be recognizable to most North Americans because most North Americans would not be able to perceive the meaning of each symbol or the words made up by the symbols. Format variables that effect recognizability include type style, word spacing, leading (amount of space between lines), and kerning (amount of space between letters).

Basic Typography

After Gutenburg invented the printing press, the primary focus on the science of typography was the creation of visible and perceptible documents. The principle typography factors related to the visibility and perceptibility of a document include type size, type style, line length, leading, case, and justification. A great deal of research has been performed with these type variables in the printed page world leading to accepted standards. Generally, research into the application of these standards to computer monitors has supported the findings of print researchers, as well as have generated research findings regarding characteristics unique to the use of screens (for example, see Grabinger, 1993) [Grabinger 1993]: contrast, resolution, brightness levels, color, font style, and visual fatigue. These findings include:

- Use only a few simple, familiar, and portable type styles. Use both lower and upper case text.
- Use type sizes appropriate for the audience and the amount of reading to be done. Be consistent in their use.
- Keep line lengths reasonable. Generally, use single spacing between lines of text.
- Left justification is adequate. Use full justification only when proportional spacing is available.

Macro Level Design: Site/Page Layout

The macro level organization of a Web page refers to the general layout. The constructs of organization and visual interest provide some heuristics for arranging text elements to create Web pages learners want to read and study from. Instead of wondering about each individual text element, you can focus on arranging whatever elements you want to use to create organized, structured, and visually interesting Web sites. Storyboarding is a great way to begin making Web site and page layout decisions. Use accepted aesthetic publication guidelines. Strive for balance, harmony, and simplicity. A good reference for these guidelines is Yale C/AIM Web Style Guide (http://info.med.yale.edu/caim/manual/).

Site/Page Layout: Macro Level	1	Begin macro level organization of the Web page by dividing the page into functional areas appropriate to desired tasks and consistent with the knowledge level of the learners. Use a header, body, and footer structure. Maintain this level of organization with only minor changes throughout the Web site.
	2	Maintain consistent internal margins and distribute the bulk of the white space around the exterior margins of the Web page to help create a sense of balance. Distribute light and dark areas and objects evenly around the Web page.
	3	Create a separate area to indicate important status and orientation information: location, page, topic, subtopic, objective, and so on.
	4	Keep any navigation controls in a separate area. Consistently use the same area of the Web page for the controls.
	5	Use graphic devices including boxes, shading, color, white space, and textures to organize the functional areas and set them apart from each other on the Web page.
	6	Avoid Web pages that are solely text without any graphic devices or illustrations. However, keep Web pages simple and avoid too many graphical devices. They can be distracting, and take the learner's attention away from what is really important.
	7	Use tables or preformatted text (although using tables is more flexible) to create a unified, clean, structured layout for your Web site.
	8	Use frames with caution. Unless implemented well, frames can cause some navigational confusion. In addition, frames can eat up a lot of a screen's real estate, making the text in each frame more difficult to read. If you are using frames to create a divided layout, consider using tables to accomplish the same requirements.
	9	When using frames, enable learners to also access the site in a non-frame format.

Figure 2. Macro Level Design Guidelines for Web Site and Page Layout

Micro Level Design: Site/Page Layout

Micro level organization of the Web page refers to structural techniques to reflect the organization of the content. The constructs of structure and organization provide some heuristics for arranging text elements to create Web pages that help learners organize the content. Micro level organization refers to how the content is presented within the overall macro level design.

Site/Page Layout: Micro Level	1	Remember that the audience is looking at your Web site on a computer screen. Select font sizes that are large enough to easily read for better visibility. Use a sans serif font for better legibility.
	2	Keep one idea per Web page.
	3	Use margins to improve readability of pages.
	4	Use indents to indicate hierarchically related subject material.
	5	Group closely related items within a box, table, or a common background color or shading. Use the same graphic devices, as well as white space, to separate unrelated or contrasting ideas.
	6	Use headings as organizers.
	7	Use directive cues (i.e., bold, italic, underlining,inverse) to emphasize important terms or ideas.
	8	If using background textures, keep in mind the "mood" you are trying to create. Also, if the background is too elaborate, text can be difficult to read.
	9	If using imagemaps for navigational purposes, consider employing an image that reflects the metaphor and/or content of the site.
	10	If you use columns to organize text and graphics, don't let the columns be longer than the screen length to avoid excessive scrolling.
	11	Set up comparison/contrast situations in a side-by-side columnar arrangement.
	12	Don't incorporate JavaScript, applets, animated gifs, or sound files unless there is a clear purpose. These elements can be time-consuming to download. If you want to include them without causing trouble for users, give users the power to decide if they want to see or hear them.

Figure 3. Micro Level Design Guidelines for Web Site and Page Layout

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Learner Support Strategies for Web Sites

Hypermedia applications, such as Web-based instructional sites, are often highly complex owing to the flexibility of environments in which they can be used and the depth and breadth of information they make available to learners. This level of complexity can leave users feeling confused and frustrated. Unfortunately, designers of hypermedia consistently make a serious error. They forget or ignore what it is like to be a novice user of a hypermedia environment. If initial support is lacking, learners may be unable to access the Web site's contents. This problem can be quite a disappointment for both the learner and the designer. Regardless of how wonderful the Web-based instructional site is, it is useless to learners who have neither the tools nor the information to access it. Therefore, providing this support based on the learners' characteristics and determined needs helps to insure that they are able not only to access and use the Web site appropriately, but also to have the positive learning experience that results from using the WBI.

Macro Level Guidelines	1	Use site maps to provide learners with valuable graphic representations of where they are within a Web-based environment. The *hyper*ness of a Web environment can be very powerful because they enable users to direct their own movement through the information. However, in power there is confusion. The more flexible the Web site, the easier it is for learners to get lost or lose track of their original goals.
	2	Provide learners with a glossary of terms that they can access at any time if the Web site includes new or unknown terms.
	3	If the site includes any real-time or timed features, provide learners with the ability to take a time out by including a pause feature.
	4	All Web sites should include detailed help information specific to the site.
	5	If your Web site requires plug-ins, allow learners to test if they have the necessary plug-ins before they become too involved in the site. There is nothing more frustrating for learners than to be interrupted because you need to go and download a plug-in.
	6	Use site maps, check lists, etc. to help learners keep track of their positions in the program.
	7	If learning is a prime objective of the hypertext, provide a chance for learners to enter a purpose or provide a menu of suggested goals to help them stay focused in the WBI environment.
	8	Design help systems with an elaborative approach. Keep initial explanations brief and provide options for more in-depth information.
	9	Always include a way to easily get back to the main page of a Web site (e.g., table of contents, site map, etc.).
	10	When using images, you can provide a low resolution version of the image, which takes relatively less time to download to a Web page, as a place holder for a high resolution version that will take longer to download. You can also allow learners to choose whether they want to view your Web site with low resolution orhigh resolution images.
	11	If your Web site is viewed better under specific conditions (e.g., with a particular browser), inform learners on the title page.
	12	If components of your Web site are "under construction", indicate this status to users before they click on a link and discover the page cannot be found. Allowing users to click on a link only to find the page with an "Under Construction" notification is frustrating to users and a waste of their time. One way of indicating that you are planning a particular link but have not completed it is to "gray out" the link; this way users know you are planning it but that it is not available yet.

Figure 4. Macro Level Learner Support Guidelines

Launching	1	To provide learners with a good first impression of your Web-based instructional site, introduce users to the site by providing a title screen.
	2	Immediately following the title screen, provide learners with information regarding the purpose, structure, and rules for using the site.
Web Site Functions	1	If you anticipate learners who are unfamiliar with a certain aspect of your Web site (e.g., using the pull-down fields, using the Back button of the browser, etc.), build prerequisite instructions into the site.
	2	To avoid early boredom (what you want is to gain attention and arouse interest), get learners involved in the site as quickly as possible.
	3	If the Web site has several sections/pages (two or more), use a table of contents as a reference point for the site.
Navigating the Web Site	1	Make Web site menus accessible to learners regardless of their position in the site. Strive to make it sothat learners only have to click on no more than two buttons to get to a menu.
	2	For more complex Web sites involving more than one level of information (e.g., main sections, primary sections, and subsections), provide learners with a site map that, when accessed, allows them to click on the area of the map they want to travel to regardless of its level in the section hierarchy.
	3	Use metaphors to help convey the Web site's navigational options to learners.
	4	Prominently display the Web site, section, and page names so learners know where they are in the Web-based instructional application at all times.
	5	Progress indicators should be used as navigational aids when one piece of information has to be divided into more than one page.
Keep Learners Informed	1	Use interactivity indicators to keep users informed about their actions within the site.
	2	If you are using images that take time to load, let learners know that there will be a delay. Incorporate text and images on the same page so learners have something to do while the images are loading.
	3	If the application includes test items, use immediate and individualized feedback to inform learners about the status of their answers to praise them for correct answers and to be supportive in cases of incorrect answers.

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	4	When learners make easily reversible mistakes, provide a forgiveness feature that allows them to undo their last action.

Figure 5. Micro Level Learner Support Guidelines

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Interactive Music Instruction with Java Objects

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Abstract: The Java Music Toolkit is a set of Java classes that can display and play musical scores. The classes are used in music courseware in which students hear problem sets and notate their solutions to the examples that they hear. Students are able to compare their solutions with correct answers to enhance their understanding of the musical thought processes involved. Courseware using applets based on these classes will run on multiple platforms and can be served over the internet. This provides students with a larger variety of interactive instructional programs and facilitates the offering of courses delivered by distance learning.

1. Introduction

When microcomputers became available for computer based instruction in the early 1980s, courseware authors were able to develop instructional materials for students in their college or university. With the current interest in distance learning, these same instructors need tools that enable them to provide the same interactive instruction remotely. This paper describes a set of Java classes that support applets for music computer based instruction. These classes enable students at any location to complete drills served from remote hosts, with the same interactivity that is possible if they were at a microcomputer at the host institution.

Serving instructional materials developed in Java over the internet has several indisputable advantages:

1. It enables students with different platforms to use the same materials, since the student's web browser will interpret the Java code and control presentation of the materials.
2. It enables students in many locations to take advantage of pedagogical methods developed and used at other colleges and universities.

2. Java for Music Instruction

2.1 Advantages of the Java Music Toolkit

The Java Music Toolkit is a set of classes that reads compressed score files and converts them both to a graphical image and to a MIDI file that can be played. These files are very small—a set of five harmonic dictation exercises, each four measures long, fits in less than 4 KB. Consequently, an entire drill with all its component exercises can be served in one step. The client will decode each score in the drill as the student needs it. If score images were served as gif files, they each could be 50KB to 500KB in size. MIDI files used to play scores typically range in size from 20KB to 150KB. The toolkit thus provides significant size and speed advantages over traditional means of transporting musical images and sound files.

The toolkit also enables the student to create scores that are solutions to dictation exercises. The classes that display scores are the same ones that enable the student to create a new score. The student could not interact in the same way with drills using images prepared with a music notation editor.

2.2 Classes in the Java Music Toolkit

The Java Music Toolkit is divided into five groups of classes:

1. Score definitions: constants that represent types of staves, ties, notes, etc.
2. Score types: data structures for notes, chords, voices, etc.
3. Score drawing: the classes that draw images, staves, clefs, notes, etc.
4. Score canvas: the graphical object onto which items are drawn
5. Score data file: the file that stores the binary representation of scores in a drill

The total size of all these classes, uncompressed, is less than 200 KB. Ideally, users of the Java Music Toolkit would download and install the classes before accessing any applet that used them.

2.3 Structure of the Score Data File

Scores are arrays of data structures, organized hierarchically. Each score is an array of systems. Each system is an array of staves. The array of data associated with each staff—its clef, key, meter, etc—describe the score's "background" elements, which are those that change little or not at all. Also associated with each system is an array of voices. The voice data—notes, rests, chord symbols, etc.—define the score's "foreground" elements. These are mapped to staves of the score, and they define the melodies and harmonies that characterize the score. Each item in this data structure has a class associated with it. The class knows how to read the data it needs from the score file and to convert the information into drawing and MIDI commands.

2.4 Displaying a Score

Each element of the score's foreground and background has a timepoint in the score. This timepoint is associated with its physical location, or placepoint, on the screen. The placepoint of any timepoint will vary, depending on the contents of the score. A note preceded by an accidental requires more space on the screen than does a note without an accidental. When chords are drawn, notes forming the interval of a second must be offset from one another, and accidentals also must be offset if they occur within the interval of the sixth. Consequently, the *ScoreCanvas* class must calculate the placepoint of each element of a score with respect to the context in which it occurs.

To prepare for drawing the score, *ScoreCanvas* creates a list of *ScoreEvents*, which associates the timepoints and placepoints of each element of a score. Each score event also has a type, which *ScoreCanvas* uses to draw the element. To draw background elements, *ScoreCanvas* sends a draw message to a *Staff* object, identifying the type of element (clef, key signature, or meter) that this object should draw on the staff. To draw foreground elements, *ScoreCanvas* sends a draw message to a *Voice* object, requesting that it draw beats on the staff at the appropriate locations.

Drawing the score background entails iterating the list of systems and staves that constitute the background and determining the physical location of each on the screen. *DrawStaffData* then invokes the appropriate drawing routine. *ScoreCanvas* has the ability to transpose the key signature of a score, so that one model score can be used to create several different examples, each in a different key.

To draw the score foreground, *ScoreCanvas* initializes voice data based on the timepoint of the current score event. After calculating note offsets and accidental offsets for chords, and aligning notes vertically, it then invokes *DrawVoiceData*. This method draws the score foreground by iterating the list of systems and voices that constitute the foreground. If a voice contains a beat at the timepoint specified by the score event, *ScoreCanvas* asks the voice to draw its beat. If not, the voice determines if its last sounding note needs a beam or tie, and if so, it draws the appropriate shape. By segmenting the score into a series of score events, *ScoreCanvas* is able to draw the score one beat at a time.

The following example shows a harmonic dictation example drawn by the Java Music Toolkit classes.
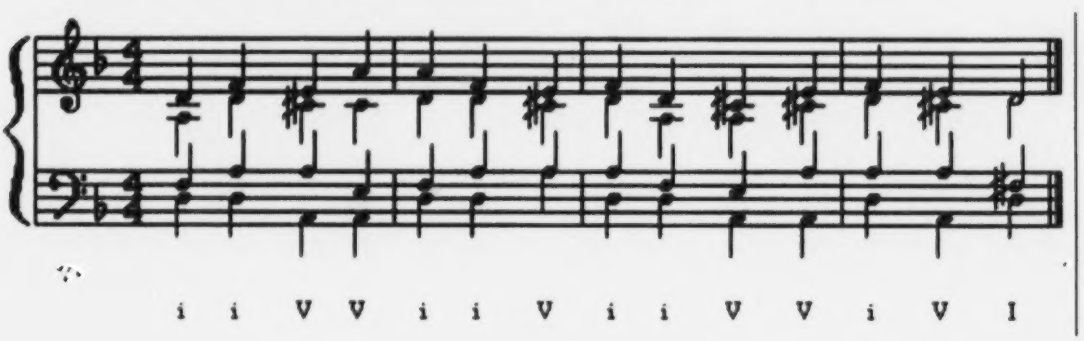
Figure 1: A harmonic dictation example.

Computers: More Effective at Feedback than Your Average Presenter?

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Abstract: While in important ways the on-line environment for educational experiences is very different than that found in the classroom, Executive Perspectives believes that the underlying foundations of why and how individuals learn is the same. We seek to replicate important interactive elements of the classroom in single-user on-line educational experiences. While in general this is difficult, we have found the use of behavioral models allows us to accomplish this goal for certain focused, important management issues.

Introduction

Computer-based and intranet-based learning have recently been the center of much hope and hype in the executive training and education industry. The hope (and hype) is based on the perceived ability to decrease training expenses via reducing travel costs, create electronic support systems for just-in-time problem-based training, and moving from a punctate classroom-based paradigm to a more continuous training effort driven by the needs of the individual. The company can also leverage its human resources via sharing the best experiences online, integrating those lesson with both internal and external content to form a "knowledge base" that can be tapped at any time for authoritative information.

Executive Perspectives (EP) is an international firm that seeks to promote organizational change via experiential education methods. While we are charmed by the vision presented above, the on-line educational environments we have developed have made us very aware of the details that accompany such a migration to the online world. For the past 14 years, EP has developed stand-up classroom education based around in-class facilitators giving coaching and debrief based on the participant's in-class experiences with a custom computer-based simulation of their business and industry. The in-class techniques we use are based on principles derived from academic research about adult learning; we and our clients have found these principles to be very effective. For us the question has not been, "Can we develop continuous on-line learning systems and web-based tutorials?" but rather "Can we develop on-line training that is as effective as our in-class training?"

We believe for many important executive training issues we can.

EP's In-Class Experience

Executive Perspectives utilizes five underlying principles from adult learning theories to design and deliver classroom experiences:

1) Adults learn best when they know what they need to learn, and how it is relevant to their personal interests.

2) Adults learn best when what they learn in groups.

3) Adults learn best when they take an action, and then reflect on what they have done (Action/Reflection).

4) Adults learn best via experiential learning.

5) Adults learn best when the learning is reinforced over time.

EP is typically contacted about specific business issues. EP develops course materials around those issues that emphasize how the course will impact the participant's capabilities in these areas, targeting item (1) above. After extensive analysis of the client's business, a computer-based simulation of the business is created that allows the participants to have input into the company's business as they would on a daily basis. This provides the basis for the experiential learning.

Someone who is an expert on the business and its issues facilitates the in-class experience. This person leads the class through the prepared materials, soliciting experiences and providing coaching on those experiences. This is an example of the action/reflection strategy in item (3) above. The class is broken into small teams for breakout sessions on particular issues and for the simulation experience, where each team "runs" a company that competes against companies "run" by other teams. During the simulation, participants must deal with the same issues they are faced with on a daily basis. The team's choices are used by the simulation model to determine their company's success; the model's output is used as a basis for coaching on how their choices impacted their business (action/reflection). After the teams have run several "quarters", the facilitator debriefs the entire class on what their experiences were, reinforcing the earlier coaching (point 5).

Our clients regard these methods as very effective, and the interactive coaching and debrief provided by the in-class facilitators is a key component of this effectiveness.

The move to online

Our clients are aware of the advances in intranet/web/computer-based training, and have repeatedly asked us to develop online versions of our in-class experiences. As described above, the reasons have mainly to do with cost and accessibility. Our in-class experiences typically take a week of top-level executive time; by moving the experience on-line the hope is that the same experience will be able to take place on the desktop in a less-demanding time frame, allowing the participant to be productive while participating in this experience.

The availability is also an important factor. The class experience described above is typically about strategic and operational issues; EP also develops soft-skills experiences using the same principles described above. Whereas there might be a few hundred executives who would benefit from attending such a course, there might be many thousands who would benefit from a soft-skills experience. Putting such a single-user experience on their desktop is a top priority of our clients.

We have looked at many CD-ROM and on-line soft-skills courses and find them to be much less compelling than our classroom-based offerings. Since we view the coaching and debrief around the simulation experience as a key component of our offerings, we were very interested in determining how to move the human coaching and debrief so important in the classroom to the on-line experience.

Online: Issues and Opportunities

The online educational experience is very different than the classroom educational experience. There are areas in which the online environment is decidedly inferior, and others in which it is superior.

Opportunities

There are two key advantages to computer-based on-line learning. First is the ready availability of adjunct materials. This is expected of on-line training applications; being able to drill down into, or find a more

appropriate representation of a particular concept is the promise of hypermedia, and to fail here is to fail your audience.

The second advantage is the undivided attention of your computer. We believe that the computer must become a much more proactive partner in your quest for knowledge and development. Computers are born passive, and will not do anything unless told to. This passivity is so pervasive that a good interface is thought of as one that lets the user explicitly tell the computer what to do as easily as possible. While we believe that excellent UI design is fundamental to any application, we feel that just as much effort should be spent getting the computer to determine the needs and capabilities of the user, and then acting on that information to provide a customized experience that more effectively supports that particular user.

Issues

The overarching disadvantage of on-line training is the lack of interactions between the participant and the facilitator and his peers. These interactions result in being exposed to other viewpoints, which is essential for reflection and cognitive reframing. The facilitator, through coaching and the debrief, provides authoritative feedback on in-class learning situations. Fellow participants share their perspectives on both in-class learning situations as well as common workplace issues. The lack of these diverse viewpoints denies on-line simulations crucial elements needed for effective assimilation of key concepts.

There are internet-based applications that work to provide a semblance of these interactions via IP telephony, shared whiteboards, and other features. While some of these technologies are promising, their usefulness is limited by scheduling constraints and the lack of the subtle cues (facial expressions, body language) that are an important part of any dialog.

EP views replicating these interactions as a requirement for effective computer-based training.

To give a quick summary, going from the classroom to an on-line environment involves a drastic reduction in the quality of interactions you can have with others, but a drastic increase in the availability of ancillary materials and of the instructor (the computer).

Constants

While there are significant differences in the classroom and on-line environments, we believe that the fundamentals of an effective educational experience, as embodied in the five points made above, remain invariant, and it follows that at a high level the design process should be similar as well. When an EP design team starts work on a project, they first define a set of simple, focused learning objectives. Throughout the design and development phase of any project, our design team continually asks the question: "What are the basic learning objectives of this training experience?" This focus results in the production of a framework in which the business issues are exposed and dealt with logically; the framework is reflected in both the classroom as well as the simulation.

Frameworks

In any training session, participants are usually asked to modify behaviors they use daily. We are telling them that this change is needed for them to become more effective contributors. What people generally need at this point is a new norm, a new paradigm, a new framework in which to view old issues. This framework is that which is described above, and typically reflects the perspective of the top executives in the company.

This framework also serves to a large extent as the basis for the coaching and debriefs by the in-class facilitator.

Focus

The frameworks that inform the coaching and debrief for classroom-based experiences are, to a large extent, ad-hoc. While EP has much experience developing successful training experiences, the framework developed for a particular company is very specialized, and has little application to other situations. They also tend to be fairly broad, which leads to the coaching and debriefs being quite open in terms of the issues that may be addressed.

It is this breadth of possible issues that is at the root of the problem for developing effective computer-generated coaching and debriefs. If it were possible to greatly restrict the possible issues, then computer-generated coaching and debrief might be useful.

Executive Perspectives has realized that this is possible, using very focused behavioral models that address many important managerial issues. These behavioral models allow EP to develop training experiences that maintain the essential features of in-class experiences while using the ability of the computer to focus on the participant to produce coaching and debriefs that are likely more informative than those of an average presenter.

Behavioral Models

Behavioral models are frameworks in which to think about issues dealing with human behaviors. Individual models have been developed over many years, with the developers gaining insight from multiple studies of test populations. They then develop reasoned frameworks in which to describe the issues and their consequences.

These models typically describe the interactions between groups of individuals; these groups are divided into functional subcategories using some metric. The behavioral aspect arises from predicting how the various subcategories will interact. Knowing the issues that might arise, the developers then describe the types of interactions that would minimize the impact of these issues.

Practically, these behavioral models result in frameworks which:
1) Describe distinct categories of individuals,
2) Describe issues that might arise from interactions among the different categories in the situation being modeled,
3) Suggest types of interactions that would serve to minimize those issues.

From the viewpoint of creating effective training experiences online, these behavioral models require that
1) The category that the participant occupies is determined
2) The participant can place individuals into their correct category
3) The participant knows how best to interact with those individuals.

Coaching and Debriefs

The focus and reasoned framework of these behavioral models solves the most pressing issues of providing effective on-line training. Coaching and Debrief are now restricted to a very focused domain; the actual coaching and debrief relies on qualities of the participant that are obtained by the computer proactively examining the participant's actions.

Through coaching, the participant actively receives positive and constructive feedback. If the feedback is positive, it acts as a reinforcement of action. If the participant is given some coaching or constructive feedback, they may be asked to think of the situation from an other view point, or perspective, which in turn, facilitates a process of cognitive reframing. Because the scenario dialogs are presented in small amounts, it is easy for the coach to respond to the actions of the participant "just-in-time". This "just-in-time" coaching allows the participant to observe his or her own instinctual behavior, while also considering, a more appropriate approach to the problem at hand. A scenario-based simulation coupled with a coach and behavioral model provides the perfect environment for experiential, action-reflection-based learning.

One exciting aspect of tailored, intranet-based based training of this kind is that it really focuses on the person as an individual. The debriefing, is the point in the exercise where the learning is tied back to specifics that are relevant to the participant's improvement going forward. This is done by the coach giving a summary of feedback to the participant based on the behavioral model.

The participant is given an assessment of their individual strengths and opportunities for improvement in relation to the behavioral model. The main goal of the debrief is to bring out the strongest parts of the learning for the participant, and give them something to walk away with in terms of what they need to improve on.

A Sample Experience: Situational Leadership

We would now like to give you a sample experience based on situational leadership [see Blanchard 1985], a commonly needed soft-skill. This example incorporates the ideas presented earlier in this paper, yielding an experience where the participant will likely receive better coaching and debrief than from a human facilitator.

Definition

Suppose you are required to build a widget. You have one helper. How you and your helper can most effectively interact to produce the widget depends on your interest in building a widget, your perceived ownership of this project, and your partner's interest and skill in building widgets. This is an example of situational leadership, and has been studied extensively by many groups over a long period of time. Situational leadership models are implemented in various ways; for this application we use a model where you (the manager) have your management style assessed, and where your subordinates are classified along two dimensions. The model presents reasoned methods of interactions for various combinations of your management style and your subordinate's interest and skill.

The key components of a successful experience are for you to become familiar with your management style, for you to be able to determine where your subordinates fall on the two dimensions of the model, and to know the appropriate interaction styles between you and your subordinates.

Scenario-based simulation

Executive Perspectives felt that a scenario-based simulation was the most appropriate means to simulate this experience. In our scenario-based simulations, instead of interacting with pro formas, spreadsheets and numbers, the participant interacts via scenarios where he interacts with characters. The participant has access to the background of the character, and what the character says to the participant. The participant can then choose a response action from a selection. The next interaction is dependent upon the choice; associated models are also influenced by the chosen action.

Experience

The experience opens with an introductory segment where the participant is given an overview of the behavioral model. He is made aware of the issue that the model addresses, the general framework the model creates, and the classifications that create the framework. The types of issues that may arise from interactions between these classifications are detailed, as are the suggested methods of interaction. This introduction contains links to textual summaries of the points made so the participant can refer to them during the scenario-based simulation.

The first part of the simulation serves two purposes: it acts to train the participant on placing individuals in the correct skill/desire classification, and at the same time the computer is inferring the participant's management style based on the reactions the participant has to the presented individuals.

The participant is presented with several scenarios. In each scenario, the participant views a character in a situation. The participant has sufficient background to correctly classify the character. The situation that is presented is written to be revealing about the classification of the participant. The participant then classifies the character, and what action he would have taken in the situation. The coaching around this situation is based on whether the participant correctly classified the character, and is drawn directly from the behavioral model.

The situations continue until the participant has demonstrated that he can correctly classify individuals. At the same time the computer has generated great insight into the management style of the participant.

The debrief is generated based on this characterization, and centers on making the participant aware of the issues he might face in interacting with different classes of individuals, and how the issues can be avoided via the use of alternative types of interactions.

In this short experience, the participant has been exposed to a reasoned framework that effectively deals with the issues he wishes to solve. He has been tutored in the framework, and on how to classify individuals. He has been made aware of his particular management style, and the issues that might arise when dealing with different individuals. He has learned alternative methods of interactions that avoid these issues. And while doing this, he has been coached effectively in a one-on-one manner, and was given a debrief that was customized to his particular needs.

This participant would be fortunate to have a classroom-based experience so complete.

Conclusion

Executive Perspectives is developing techniques for maintaining key elements of the classroom experience in an on-line setting. For many important management issues, the use of very focused behavioral models allows for the development of on-line experiences that do maintain these elements, and may well give the participant a better experience than that provided by an average in-class presenter. Executive Perspectives is looking for methods to extend these capabilities to situations that are not as focused as those detailed here.

[Blanchard 1985] Blanchard, K. *et al.* (1985) *Leadership and the One-Minute manager: Increasing Effectiveness Through Situational Leadership.* New York: William Morrow

Education, Multimedia, and Psychoanalysis

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Abstract: The first issue we are going to present is education in relation to multimedia and psychoanalysis. In this part of our speech we want to express our personal conviction that multimedia and psychoanalysis constitute the problem as such in education. To the present days in our country psychoanalysis has existed almost only on the clinical level and for bulk of psychoanalysts it is impossible to break the walls of the consulting room and enter the classroom. Educators do not know what they can take from psychoanalysis to improve their professional work. From the multimedia point of view there is a similar difficulty. Teachers are not familiar with richness offered by multimedia technology. We are going to discuss the ways multimedia and psychoanalysis can enter into the process of education. The second problem we would like to describe is devoted to a rather bizarre, we mean, suspicious presence of psychoanalysis in the world of multimedia. We are ready to defend the thesis that the multimedia constitutes the new horizon for psychoanalysis. The third task of ours is to connect the psychoanalysis with the question of understanding. We perfectly know that analysts are doing their best to understand patients. They are also doing their best to understand themselves. We are discussing the role of insight in the process of education. Looking back at the history of psychoanalysis we can notice one of the fundamental controversies. It is a question what is the most important factor of successful treatment. Is it an analyst's personality or maybe there are only appropriately applied techniques?

It is not a coincidence that three people co-sign this paper. Each of us is engaged in a different discipline. Czesław Dziekanowski is a psychoanalyst, Jacek Górnikiewicz is fascinated by educational transformation, Arnold Toczyski by multimedia. We hope that our speech will expose particular significance of the meeting of these three different disciplines.

Without a doubt the appearance of multimedia has changed the status of educational activities. One can, of course, ignore the presence of multimedia in education, which is what most teachers still do in Poland. When we think about the cause of that situation different possible answers come to mind. Ones say, that the Polish laziness can be blamed. Some fiercely accuse technology of destroying spiritual values safeguarded by God and Nature. Others point out an economical aspect that limits us. And the others repeat: do not hurry, wait, we still have time, so they temporize the process. The frequently used argument is that multimedia serve an entertaining – not educational purpose. But we are convinced that the crucial problem here is rather unconscious anxiety. This fear distorts our perception, multiplying and magnifying obstacles. It is this fear that makes an average Pole feel permanently threatened. That menace is double bound – one in the presence, the second in the past. Just now the average Polish person feels the jaws of the monster called multimedia. We call it the jaws of the monster because nowadays multimedia seem to be another embodiment of a traumatic archetype of invasion. Those who know even superficially the history of Poland know what we mean: the partitions of Poland, the wars, etc. We suggest that now multimedia play that inglorious part of symbolizing another form of invasion. The described situation allows easily to foresee the future task for our education: to free our society from the demon of multimedia. How are we supposed to achieve that? We think that the most efficient way, especially from psychoanalytical point of view, would be to make the society aware of the nature of the demon. But what should that process of making conscious mean specifically? We should create a certain attitude among the educators, based on the function of

understanding. That is analogues to the role the psychoanalyst assumes towards their patients. The educators and their understanding should enable the society to see into the true nature of the above-mentioned obstacles, which are more defense mechanisms (mostly rationalization, projection and denial) than actual problems.

But for the educators just like me (Jacek Górnikiewicz) fascinated by the transformation of the education it is difficult to think of multimedia in such an extreme manner – as a nightmare or as a sacrum. I approach multimedia pragmatically, free from utmost emotions.

For me (Arnold Toczyski) – a multimedia specialist at the University with the ambition to be the leader in promoting the latest educational techniques, the visits of different people interested in using multimedia is real anguish. It is not easy for me to know those people's real needs because of their usual excitement caused either by exaggerated fascination of potential possibilities of multimedia or just the opposite - by the demonized difficulties and dangers in utilizing them. Over and over again I ask myself why after so many years of experience it is still so hard for us to communicate. I think that the main problem is the lack of the common language. In that situation common sense demands to blame individual persons. But I known that our unfortunate relation is based on more general context. What I mean is the dual nature of our culture in which two paradigms: humanistic and technological hardly intermingle. Simplistically speaking, humanists misunderstand technocrats and vice versa. To face the challenge of our times we have to overcome this unfavorable situation the one-sided progress has entangled us in.

Perhaps this is the right time to consider seriously the role of multimedia in psychoanalysis. So far in our paper we have treated the science created by Freud as useful in the educational development of the society especially in relation to assimilation of multimedia as effective tools of work and development. Surprisingly and paradoxically, the psychoanalysis itself seems to underestimate multimedia as a desired tool in the psychoanalytical process. Intimacy is one of the crucial values constituted in the consulting room. The question is whether the modern media are able to work within the limits of intimacy. Freud writes that the psychoanalysis is not possible without the presence of an analyst. The introduction of multimedia into our world makes us think again what the presence of the analyst really means. Many analysts have already given some thought to the idea of their absence and presence in psychoanalytical relation. Their thinking was limited by the conclusion that although psychoanalysts and patients are physically together they are nevertheless alone. The most general and at the same time the most basic goal of the psychoanalytical process is to lead the patient from the dependent relation to freeing them from that. But the still valid principle is the one of anonymity in the relation psychoanalyst – patient. In order to be consistent one has to admit that it is much easier to fallow this postulate for the analyst who works on the computer terminal. We cannot imagine that this attractive potential in multimedia should escape psychoanalysts' notice. Thus, we suspect that the psychoanalytical world will split into two parts. Those who are afraid of destructive influence of multimedia on psychoanalytical process will definitely reject them. But those who are intrigued by the new possibilities will try to experiment to learn the new things about the nature of psychoanalysis and will want to know whether psychoanalysis will manage in the world inevitably changing under the multimedia revolution.

The Efficacy of Distance Learning in Affecting Attitudinal Change

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Abstract

This paper looks at the importance of distance education in reaching a larger and more geographically dispersed group of students. The authors focus on technology-mediated distance courses that are concerned with affecting attitudinal and behavioral change. Because these courses place a greater emphasis on process, as opposed to content, pedagogical approaches that utilize role-play, debates, experiential exercises and other face-to-face strategies have been effective means of changing attitudes and behaviors. The source, message, medium and audience are important factors that have an impact on attitudinal change. This paper looks at each of these factors as they relate to technology-mediated distance education. If higher education is going to successfully implement entire programs at a distance, it must find ways to enrich the distance learning of process-oriented courses. The objective of this paper is to compare the effectiveness of traditionally taught versus distance courses in affecting attitudinal changes.

The first stage of this research is to determine if attitudes are indeed changed in traditionally taught classes. The first class that we use is an undergraduate course in conflict management. This course was taught on campus using various methodologies such as case studies, lectures, guest speakers, debates, etc. Students were given a questionnaire at the beginning of the semester and at the completion of the course. In addition, a survey was administered at the end of the semester to determine students' impressions of their learning, and of any changes they experienced in their conflict resolution styles.

A thirty item "behavioral description questionnaire" provided the students' scores at th e beginning and completion of the course on these conflict resolution styles: competition, collaboration, sharing, avoiding, and accommodation. We computed a t-test that showed statistical significance in competition, collaboration, and accommodation. The fifteen-question survey of students' perceptions of their attitudinal changes used a five point strongly agree (1) to strongly disagree (5) scale. The means for all of the questions ranged from 1.79 to 2.73.

This first stage demonstrated changes in attitudes in a traditionally taught conflict management class. It provides a baseline for studying the efficacy of technology-mediated distance education, and in helping us to determine the most effective technology to utilize in process-oriented courses.

Virtual URLs for Browsing and Searching Large Information Spaces

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Abstract: As an information space grows, it becomes more difficult to find the information you seek. Nowhere is this more evident than on the Web. This paper presents the use of Virtual Resource Locators (VRLs) to facilitate browsing conceptual information hierarchies, or taxonomies. In this project, URLs on distributed web servers are classified under one taxonomy. Using a standard browser, a web visitor can reach any page in the collection using its VRL. A VRL is a logical name corresponding to the position of the page in the taxonomy. VRLs mask inconsistent URLs on distributed servers organizing heterogeneous information spaces into a consistent logical structure. The process that resolves VRLs into URLs, the VRL Mapper, also supports user input of partial or incorrect VRLs. Rather than give you an error message, it automatically performs a heuristic search and presents the user with valid alternatives.

Introduction

The IBM Intranet is a complex information space containing over a million web pages hosted on more than three thousand servers across the world. Semantically similar pages, or ones relating to the same subject, are often stored on different servers and not linked to one another. For example, even if an employee finds a good starting point to download software, the employee probably misses many other sites that host downloadable software of interest. The problem of locating content is familiar to any corporate site of moderate complexity.

One solution is to rename hosts, directories and pages so that the corresponding URLs reflect the content. However, this breaks existing links to the pages, create load-balancing problems, and forces authors to relearn the web space when updating their pages. Another solution is to modify the search tools. Users are often forced to choose between browsing and searching. Browsing is appropriate when a collection is well organized, relatively small, and the user does not know how to form valid queries. Searching is more effective when the information space is large and disorganized, but the user knows a few discriminating search terms. In most cases, neither is sufficient. Toggling back and forth between searching and browsing is often the most effective strategy. Unfortunately current tools make this cumbersome.

Our approach is to create a virtual service. In a virtual service, a heterogeneous collection is structured into a single, logical information space. The service presents an integrated interface that minimizes the physical and cognitive load of switching between browsing and searching. Various search algorithms can take advantage of this organization and limit result sets to categories and/or subtrees of the taxonomy. This is similar to other structured information stores such as on the Yahoo website. A virtual service begins with webmasters at different sites classifying pages within a single hierarchical organization, or taxonomy. While the physical location of pages is unchanged, pages on the same subject get grouped together under the taxonomy. The new organization masks the existing inconsistent names of hosts and directories. Each page now has a logical address, or VRL, that reflects its position within the taxonomy. A more stable information space is created because a taxonomy does not change as rapidly as individual pages classified within it.

As users of the virtual service navigate the new information space, the VRL Mapper handles their requests. The VRL Mapper never lets a user-entered VRL fail. Instead of giving the user an error message for an invalid URL, the Mapper tries to find nodes or pages based on the VRL requested. The inference rules and explanations of the VRL Mapper improve upon standard web server error handling.

The IBM Intranet virtual service is based on a relatively small taxonomy consisting of less than 300 nodes with a depth of about 4 levels. The taxonomy reflects the contents of the IBM internal web and contains information from corporate communications and personnel information to software downloads.
This paper starts by defining VRLs and the VRL Mapper process. Then, it describes taxonomy creation, management andclassification. Finally, the paper covers related work and a conclusion.

Virtual Resource Locators

A Virtual Resource Locator is the logical address of a piece of information. A VRL has the same syntax as a URL. While a URL describes a physical location on a server on the net, a VRL describes a logical location within an information taxonomy. The goal is to make a VRL address more meaningful and easier to understand. Because items can be classified under more than one taxonomy category, a page may have several VRLs. This allows users to access the same information from a number of different perspectives.

The process of classifying a page into a category in a taxonomy creates metadata, or information about the subject matter of the page. Usually, metadata is stored either in a metadata server or as special tags in the page, like the markup in an XML document. Because the VRL Mapper needs fast access to the taxonomy and the metadata associated with all the pages, the classification metadata is stored in a centralized relational DB2 database.

VRLs behave like URLs. Each category in the taxonomy and each classified page can be addressed using a VRL. A user simply types the VRL into the URL field of a standard web browser or embeds them in html pages. No additional software or configuration of the user's machine is required.

A VRL can be implemented on the server in two ways, an explicit form or an implicit form. The explicit VRL shows the name of the virtual service, while the implicit VRL does not. An explicit VRL has the following format:

protocol://host/v/service/category/.../page.html

protocol: VRL Mapper uses the http protocol
host: the name of a web server that recognizes a virtual URL
v: the virtual tag indicating an explicit VRL
service: the virtual service name (this paper describes the web service, others include news and personnel dire ctory)
category: a node in the taxonomy
page: the name of the page within the taxonomy

An example of an explicit VRL is *http://w3.ibm.com/v/web/What_We_Sell/Software*. In the explicit model, the web server's forwards any URL with the top directory "v/" to the VRL Mapper. The string "web" indicates that the VRL belongs to the IBM Intranet virtual service. "What_We_Sell" is a top level category in the IBM Intranet taxonomy, and "Software" is a subcategory under it. The implicit VRL for the same category is *http://w3.ibm.com/What_We_Sell/Software*.

VRL Mapper Process

VRLs are processed in three steps: a forwarding phase, a resolution phase and a page generation phase.

Forwarding Phase

In the forwarding phase, the web server running a virtual service sends VRLs to the VRL Mapper. The first step is to differentiate a VRL from a normal URL. In the explicit VRL model, the server forwards any virtual URL with a "/v/" after the host name to the VRL Mapper.

In the implicit VRL model, the host web server is configured to forward all top level category names to the VRL Mapper. In addition, the server forwards erroneous URL requests. When the server fails to locate and serve a URL, it does not generate an error message. Instead, the request is passed to the VRL Mapper which offers valid options. The advantage of the implicit VRL is that it cannot be distinguished from a regular URL while still supporting the user in finding information. Any server on the net can be configured to do these mappings.

Resolution Phase

During the resolution phase, the VRL Mapper uses a browse & search algorithm resolving in one of three information types, a category in the taxonomy, a classified page, or a collection of categories or pages. By

comparing the entered VRL to the categories in the taxonomy, the VRL Mapper handles incomplete or erroneous input as best as possible. If the Mapper cannot find a taxonomy category or page that matches the VRL, it launches a series of searches, enlarging the scope for increasingly "fuzzy" matches.

The VRL Mapper is implemented as a Web Browser Intelligence (WBI) agent WBI. Developed at IBM Almaden's USER research group, WBI is a system that organizes agents to observe user actions, proactively offer assistance, and modify web documents (http://www.almaden.ibm.com/cs/user/wbi/wbipaper.html). A WBI proxy can monitor the stream of data coming from the client browser, modify the stream going back to the client, and record the activity between the client and the web. In our application, WBI runs on a server and at startup time loads the complete taxonomy into memory. This one time cost allows for relatively quick processing of VRLs during runtime. During runtime, the VRL Mapper applies its knowledge of the entire information space to support a user browsing and searching through the taxonomy. It uses features of WBI to redirect to an actual URL or modify the HTML returned to the client.

When faced with an invalid VRL, the Virtual Mapper keeps the valid part and searches on the remainder. For example, the VRL *http://w3.ibm.com/v/web/what_we_sell/soft* is partially valid: it exactly matches the top level category "What We Sell" but "soft" is not a sub-category under What_We_Sell. The Virtual Mapper uses "soft" to begin the browse & search algorithm. In this case, the matching is simple since "soft" completes only to the "Software" category under What_We_Sell. The user is presented with the unique match of the typed in VRL.

Browse & search algorithm

The VRL Mapper transitions smoothly between the various stages of the browse & search algorithm. This search can be characterized by three attributes. The first is the scope within the taxonomy: the immediate children of a category, all of the descendants of a cateogory, or the complete taxonomy. The second browse & search attribute is the content which the Mapper compares to the VRL. The content can either be the name, alias, keywords or description of a category, or the text in the body of a classified page. Finally, the method used in the matching process can either be an "exact" match, a "starts-with" match, or a "contains" match. The three attributes become less constrained as the browse & search algorithm advances. The attributes are summarized in Table 1.

Scope	Content	Matching Method
children	category name	exact
descedants	category alias	starts with
entire taxonomy	category keywords, description, page bodies	contains

Table 1: Browse & Search Attributes

In theory, the browse & search algorithm ought to exercise every combination of scope, content and matching method in its full complexity. In reality, the IBM Intranet taxonomy is relatively small and the resulting algorithm would be rather tedious. Instead, the browse & search algorithm is collapsed into a sequence of seven steps presented in Table 2.

Step	Scope	Content	Matching Method
1	children	category name	exact
2	children	category name and	starts with
3	descendants	category name	exact
4	descendants	category name and alias	starts with
5	entire taxonomy	category name, alias, keywords	contains
6	descendents	page bodies	exact
7	entire	page bodies	exact

Table 2: Browse & Search Algorith

Users learn how resolution gradually turns into a search across the entire taxonomy and classified pages. As a result, users can force the VRL Mapper to bypass early stages of resolution and imbed a search request directly in the VRL string. If the VRL includes a question mark, "?", the VRL Mapper treats the remainder of the VRL as input to the search process. This search goes directly to step 5 in the browse & search algorithm. If the VRL contains a double question mark, "??", all subsequent characters are treated as input to step 7 in the algorithm. The VRL mechanism allows the user to go directly to searches of differently scopes. For example, a VRL to find a category in the taxonomy related to Java might be *http://w3.ibm.com/v/web?java*. When processing this VRL, the VRL Mapper

searches the entire taxonomy for categories that contain the substring java in the category name, alias, or keyword field. To simplify the search process, all generated pages include a type-in area and a button to initiate a search over the entire web taxonomy, as well as over all services.

The VRL resolution is unlike the URL completion in the Netscape 4.0 browser. The browser maintains a history of sites the user has recently visited and completes any partial URL with the latest visited matching URL. The VRL resolution resembles more the Emacs editor command completion. Both present all valid completions to a valid partial string. However, Emacs completion always matches from the beginning of the string, while VRL resolution falls back to a "contains" search method, where a VRL is matched with substrings of category names, keywords, and aliases.

Page Generation Phase

The final phase of VRL processing is the generation of a results page for the user. The VRL Mapper generates three types of pages, one describes a category in the taxonomy, a second lists a set of choices from an ambiguous VRL and a third presents the web page classified within a category.

When a VRL matches a category in the taxonomy, the VRL Mapper displays the VRL with each segment as a hyperlink, allowing a user to easily move up the taxonomy to higher categories. The description of a category is a free text explanation. Keywords provide additional ways to search across the taxonomy. The children of a category are hyperlinks. A home page is a good starting point for browsing pages in a specific category.

If more than one category fits the VRL typed in, the VRL Mapper generates a page with all valid matches. For example, if the user types in the ambiguous request http://w3.ibm.com/v/web/what_we_sell/s, the system lists "Software", "Services" and "Solutions" because they are valid subcategories of "What We Sell"

If the VRL points to a web page classified within the taxonomy, the VRL Mapper returns the page with a header with the one or more VRLs that correspond to the page. This implementation is simple for the user but has the drawback of changing the HTML. This may cause unwanted problems in the presentation of that page. Another alternative is to provide a separate, smaller window that pops up to indicate the multiple VRL paths to the specified web page. We are continuing to investigate these design tradeoffs.

Taxonomy Creation and Management

The VRL project builds on two components: a hierarchical information taxonomy, and a collection of web pages classified under the taxonomy. An on-going IBM Intranet Classification project provides these two components. Creating a taxonomy for a large web collection like the IBM Intranet is no simple task. Users come to the Intranet with different needs and questions in mind. One organization hardly fits everyone's mental models [Lakoff 87]. But as we know, any organization is better than no organization [Sano 96]. If presented with a stable taxonomy, users will learn to use it.

The Intranet taxonomy was entered into a database using an IBM internal toolkit that supports the management of database driven taxonomies. The toolkit also allows webmasters to classify web pages into one or more categories in the taxonomy. The webmaster can also flag a page as a "home page" if it serves as a starting point to a lot of relevant content.

The process of classifying over million pages is daunting. Our strategy is to manually classify prototypical pages into the taxnomy. Then, for each unclassified page, an automatic classification algorithm uses these manual samples as the seed documents in classifying the page. Currently, these automatic classifications are reviewed by a human. Their task is narrowed down to "accept or reclassify" rather than the more time-consuming "where does this page belong?"

The IBM Intranet taxonomy has been carefully designed by a group of experts familiar with the content on the Intranet. (http://cs-tr.cs.cornell.edu:80/Dienst/UI/2.0/Describe/ncstrl.cornell%2fTR86-765?abstract=text+clustering)
An alternative to manual taxonomy creation is the automatic category creation based on the pages themselves via a technique known as hierarchic clustering. Clustering groups documents by similarity and dynamically creates labels

for the groups. While a carefully edited taxonomy holds more meaningful labels, assuring that it reflects content changing over time requires manual changes. On the other hand, a discovered taxonomy always reflects the content, but holds labels of concatenated words, instead of more meaningful concepts.

Related Work

A URL (http://www.w3.org/Addressing/URL/url-spec.txt) is the address of a retrievable object, an address bound to a physical location. Combining the address and the location of an object prevents any abstraction of how to access the object. Some work has been done to overcome this limitation. "Persistent URLs" (http://purl.oclc.org/) maintain a many-to-one mapping from potentially several URLs as addresses to another URL as a location, so that the persistent URL can be used in a stable fashion. This is very similar to the way Post Office Box addressing works in the physical world -- mail addressed to a POBox may be delivered to that box, or to some other actual address, with the redirection being done invisibly to the sender. As an example, if http://www.kaput.com/index.html is a persistent URL, then a connection to it may be redirected to any of a number of different actual URLs.

URL addresses and locations are mapped many-to-one, addresses being aliases of a URL location. This mapping limits the information space of the WWW to one dimension. Metadata, such as defined by Uniform Resource Characteristics, or URCs, add dimensionality to this space. URC metadata allows for a flat file to have many attributes, such as abstract, access, author, date and time, location, review, signature, subject, title and version. But missing from URCs is the ability to position a document withing a structured information space.

Work in virtual names has a precedent at IBM. The Web Object Management (WOM) server, the web server that hosted the Official 1996 Olympic Web Site, used virtual naming. Pages were composed of text and multimedia items stored in the server as unique objects with metadata. The virtual URL path that appeared in the client browser was a string stored as metadata with the object. The underlying architecture of WOM was designed to serve objects based on their virtual names. A virtual URL was mapped to the internal name of an object without the use of a proxy server. The VRL Mapper is an extension to a web server that does not support virtual naming, such as Domino, IBM's Go, or Apache. While WOM supported only one virtual path per page, the VRL Mapper supports several. Furthermore, WOM did not construct virtual paths from a centralized taxonomy.

As web-based systems are becoming more "intelligent", tagging pages with metadata is becoming more common. XML is emerging as a standard for imbedding metadata within the markup of traditional documents. The VRL approach separates the metadata into an external store. Any processing refers to that store to retrieve the metadata for a document. An advantage is the easy execution of relational queries on metadata for all documents. In the future, the VRL Mapper could dynamically modify the documents it serves by imbedding XML tags with metadata from the central store.

Yahoo (http://www.yahoo.com) is probably the best known web-based taxonomy. It supports search within a predefined hierarchy much like the VRL Mapper. In fact, the VRL Mapper could import the Yahoo taxonomy and make the hierarchy available directly in the syntax of the URL. Furthermore, a VRL Yahoo service would provide helpful hints to erroneously entered URLs.

The Pan-Browser (http://www5conf.inria.fr/fich_html/papers/P15/Overview.html) supports the creation, presentation, viewing, and control of user created metadata. [Schickler 96] The metadata is stored separately from the documents. The prototype is focused on attaching annotations to HTML documents and using it in multiple ways, such as trails, voting, and seals-of-approval.

WebCutter (http://www6.nttlabs.com/HyperNews/get/PAPER40.html) is a dynamic mapping system that tightly integrates browsing and searching. [Maarek 97] WebCutter tailors the map it creates based on concepts relevant to the user. As defined by WebCutter, searching involves engines that use text analysis tools over a set of documents, while browsing uses site mapping and visualization techniques. Unlike Webcutter, the VRL Mapper lets users browse and search over a predesigned, logical taxonomy that reflects the space of all documents. This "meta-search" allows users to focus on the type of information they are seeking before searching the information itself.

Conclusion

A virtual service supports users in exploring a heterogeneous distributed information space. Documents in the collection are structured into a single, logical information space. Each document has one or more virtual addresses, or VRLs, reflecting its positions within the taxonomy. While the physical location of documents is unchanged, the virtual names mask the existing inconsistent names of hosts and directories.

As users of the virtual service navigate the new information space, the VRL Mapper handles their requests. The VRL Mapper never lets a user-entered VRL fail, instead it tries to provide relevant options. The system also explains how it comes up with the options. The inference rules and explanations of the VRL Mapper improve upon standard web server error handling.

The Intranet information space is the first in a series of virtual services planned for the IBM Intranet. Other services include information spaces for the internal news stories and the employee directory. For rapidly changing content, such as a news feed, categories change from week to week as new topics emerge in the news. Unlike the intranet, a news application must support a continually increasing set of categories.

The Intranet virtual service is currently running as an early prototype. The next phases of the project will tell how well the current VRL implementation scales to support the increasingly high hit rates on the IBM Intranet. IBM's Network Dispatcher technology is a possible solution to balance user requests across multiple VRL Mapper servers running in parallel.

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A Laboratory Course for Undergraduate Students of Phonetics.

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Abstract: A laboratory course for undergraduate students of phonetics has been developed and tested at the Department of Phonetics at Umeå university. The course consists of exercises designed to acquaint the students with basic acoustic analysis methods and a section on speech perception. All instructions were in the form of web pages. Questionnaires, assignments and student tracking were administered using Internet-based tools. Acoustic analyses were made using the ESPS/ *Waves+*™ analysis package; the perception experiments were run either entirely within a web browser or called from a web page but run in a separate X-window. Data collection and analyses were made in the UNIX environment and the results sent back to the students in the form of Java applets readable in web browsers.

1. Background

Laboratory work in phonetics or speech science is particularly well suited for telematic teaching. Students often work alone or in small groups, analysing their own voices or stored data, using computer-based analysis tools. Traditionally taught laboratory courses could therefore quite easily be transformed into telematic courses as far as content and methods are concerned. However, present limitations in bandwidth make the transfer of speech data too slow to be practical. This problem can be circumvented by storing the sound files on the local computer and running the analysis programs locally for example as Java applications. However, today there are no analysis tools available in versions that run inside a web browser, locally or over the Internet, and the sound handling capability in Java is still too poor to be used for things other than demonstrations. It is highly likely that these problems will be overcome in the not too distant future. But until that happens, a laboratory course like the one described here, will have to combine Internet based components with components which run outside the Internet environment. Instructions, examples and demonstrations, course administration and student tracking may all be run in an Internet environment while audio files and acoustic analyses are better handled outside the Internet environment, typically locally on the users' own machines.

2. Course Objectives

A laboratory course for undergraduate students of phonetics, recognising the present limitations, has been developed and tested at the Department of Phonetics at Umeå University. The laboratory course was time-tabled towards the end of the first semester of a full-time course on phonetics.

The goals of the course were for the students to become familiar with

1) basic concepts of the acoustic analysis of speech

2) basic tools used in the acoustic analysis of speech and learn how to use them for simple analyses

3) fundamental concepts and problems in speech perception

4) experimental techniques used in speech perception research

3. Course Structure and Content

The course consisted of 17 laboratory exercises, each centred on a given topic and included suggested background readings as well as demonstrations and experiments. The total number of contact hours was thirty, but students had access to the laboratory outside these hours and were free to work through the course at their own pace, but within given deadlines.

All instructions for the laboratory exercises were in the form of web pages, but the course recommended textbook was used for the background readings. Questionnaires, assignments and student tracking were administered using Internet-based tools. This part of the course was developed with the help of the WebCT [URL1] course development tool.

All acoustic analyses were made outside the Internet environment, using the ESPS/*Waves+*™ analysis package. Since the instructions for the exercises were made with a particular analysis package and computer environment in mind it was possible to tailor all accompanying illustrations so that they corresponded exactly to what the students encountered on their screens as they performed the experiments. Experiments and measurements were performed on pre-recorded material accessible as digitized sound files. Although the equipment would have allowed on-line recording this option was not used because earlier tests had shown the sound quality of such recordings to be too poor for the analyses to be undertaken. The sound files contained simple and complex non-speech signals as well as recorded speech illustrating various linguistic phenomena such as VOT, vowel quantity, fundamental frequency contours. The non-speech signals were used to familiarize the students with analysis techniques and units used in describing acoustic properties like decibel and Hertz. In the speech files students measured selected acoustic parameters and were asked to reflect upon their significance for speech production and perception.

The perception experiments were accessed from a web page. All programs were written in Java and could in principle run as Java applications inside the browser but due to the rather poor sound quality in Java, only one of the experiments was delivered this way. The rest ran in windows outside the browser and used audio tools from the UNIX environment. Data collection and analyses were also run in a UNIX environment. The results were sent back to the students in the form of Java applets readable in their web browsers. The student's own result was presented, in the form of a diagram, immediately upon the completion of the experiment, and the combined result of the whole group of students was presented in another diagram. The diagram showing the results for the whole group could be updated at any time to include the most recent results until all students had completed the task. The perception tests were chosen to illustrate some basic properties of the auditory system such as temporal integration and the threshold of hearing. In addition a re-creation of a classical test on Categorical Perception was included.

4. Environment in Which the Course was Taught

The laboratory in which the course was given was equipped with nine Sun Ultra 1 SparcStations connected to the university network. Each computer was equipped with three headphones so that students could listen to the sound files they were working with without disturbing other students or groups. The number of students taking the course has ranged from 15 to 20. During contact hours students thus had to work in groups of 2 or 3. Although students were, thus, allowed to work in groups, all assignments had to be handed in (i.e. submitted over the net) individually. Outside contact hours they often worked alone.

5. Results

The course has been given twice to first semester phonetics students and also once to a group of speech therapy students. Most students had no, or very little, experience with computers. Needless to say, this caused some initial problems, but this disadvantage was outweighed by the students' feeling that the exposure to computers and the Internet was something generally beneficial and a kind of knowledge that would become useful to them in other contexts. Comparing the students' results on theoretical parts of their written tests and assignments, they performed on par with students in previous years when the course was taught in the form of lectures supplemented by a few laboratory exercises. Their command of analysis procedures was, however, markedly better as was their understanding of these procedures and the relevance of acoustic analysis in the study of speech. Their understanding of experimental techniques and results in the field of speech perception was also improved. The immediate feedback of the results of their own perception tests and the possibility to view the accumulated results develop, as more subjects completed the task, gave them deeper insights both into experimental techniques as such and the particular aspects illustrated by a given test.

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[URL1] WebCT is a course-authoring tool developed at the University of British Columbia. More information may be found at: http://homebrew1.cs.ubc.ca/webct/

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Developing an Internet Section of an Introductory Course in Information Systems

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Abstract: This paper describes the development of an introductory course in Information Systems that is taught in a learner independent mode using the Internet. The paper focuses on the conversion process from the face-to-face format into the Internet-based independent learning and highlights some of the issues found during the conversion efforts.

Introduction

There is a tendency to view education on the Internet as a universal innovation applicable to all types of instructional situations. It is true that Internet-based independent learning (IIL) has the potential for a fundamental and beneficial transformation of higher education. By combining the best aspects of our present university systems with the opportunities offered by the Internet, distance independent learning could lead to the creation of high quality, highly individualized instruction and the creation of student communities which transcend the limitations of time and space [Besser and Boon, 1996 and Jorn, Hill, and Walstrom, 1996]. However, there are also some negative effects of the widespread adoption of these new instructional delivery vehicles. A number of important questions need to be answered before Internet-based independent learning can fulfill its potential and become a tool that augments and supports traditional education rather than just cheaply replacing it. In this article, the authors describe the process being used to move the End-User Computing course (IS 215) from a face-to-face lecture delivery to a student-centered delivery structure using the Internet.

Background

The three-credit End-User Computing course is a service course that is offered to every student in the College of Business. Students must take this course during their sophomore year. The course provides an overview of the concepts, tools, and methodologies related to the use and design of information systems. The course description in the 1996-1997 catalog is:

> *Managers and professionals are using computers more extensively. This revolution is known by the name "End-User Computing". Students learn traditional information systems topics such as software life cycles, transaction processing systems, and business problem solving. In addition, a wide range of applications including Decision Support Systems, Executive Information Systems, Non-clerical Office Automation, Data Communications, and Local Area Networks are covered. These applications cover all the functional areas of business. Coursework includes conceptual as well as laboratory material.*

This course was chosen for Internet delivery because: (1) the focus of this course is primarily conceptual, (2) it presents students with a fixed wide but shallow set of skills, knowledge, and goals, thus a more suitable prospect for Internet medium, (3) it is a multisection course, providing a choice for a larger number of students.

Students enrolled in this course are required to learn the basic concepts and functionality of information systems including decision support systems, expert systems, network systems, database systems, and support systems. In addition, the course must also provide hands-on experience in using spreadsheet, wordprocessor, database, and decision support systems applications. The current course structure consists of a three-hour lecture per week to the entire class followed by individual student work in the open computer laboratory. In

addition, students were requested to attend a number of workshops to learn specific applications such as Microsoft Excel, Microsoft Access and Microsoft Word and to learn about email, web page development, and FTP. The three classroom hours per week were dedicated to the presentation of the course's topics, answering questions concerning problems encountered in executing exercises, and describing project requirements. Student tutors were available in the open laboratory to answer application specific questions. The text used for the course was Introduction to Information Systems 8th edition by James O'Brien.

The primary problem in the current structure is the wide variation in the student's entry level computer skills (15 percent of the students have all skills for 85 percent of the course's hands-on competencies, 25 percent have never used a computer, and 67 percent do not have keyboarding skills).

New Delivery Structure

Two major changes in the structure of the class were implemented:

1) provide access to instructional material critical for independent work on the applications through a course home page on the web;
2) divide the students' learning experience into two components, namely an independent component where students learn concepts and applications on an independent basis and through a weekly one-hour traditional class meeting.

The web was chosen for the delivery mode over an implementation using authoring software because it is platform independent and students could access the course from home using local web service providers. In addition, the new structure must support: unit testing on demand, independent access to tutorials on major application software concepts, and opportunity for experienced students to explore and learn advanced functions in the software applications.

New Course Elements

The new course has the following elements online:

Course syllabus and general course information: The standard information normally distributed through a course syllabus is included.

Late-breaking news and course information: A "Latest News" section on the main web page of the course provides communication from the instructor to the class for weekly course information. This is the primary communication link to students working independently on the course.

Workshops and lecture schedule: The schedule for demonstrations and application lectures in the traditional classroom and a schedule for the hands-on workshops are included in this element. Students use the schedule to determine the class lectures and/or workshops they need to complete the unit exercises. Skilled students may attend few lectures; however, a student new to computers might attend every lecture and workshop.

Application exercises files: Required exercises in each of the software applications are included. The exercises include basic work from the text or web files to learn the specific software applications.

Test schedule: A test schedule is provided on-line. Tests are conducted on-line making it possible for the student to know the results of the test immediately.

Team building exercise files: Two exercises in team building are included to prepare students for work in teams in this course and in future courses.

Issues

During our developmental efforts we encountered a number of issues that need to be taken into consideration before an effective system can be developed. Following Hartly [Hartly, 1996], we classified these issues as administrative/academic, technical, and societal.

Administrative/Academic

Administrative support: Without support from the administration to facilitate the introduction, maintenance and effective operation of WWW based educational systems, development of such systems will be hampered.

Development time: Internet-based educational systems take substantially more time to develop, set up and maintain than traditional courses. Thus, it is important to be conservative in the introduction of new systems to avoid overreaching the lecturer's capacity and ability.

Administrative acceptance of WWW educational tool construction: Again, without the support and recognition from the administration by making the development of such systems a viable part of faculty load and including it in tenure and promotion consideration, very few instructors will start developing such systems.

Student type: Systems must be designed with regard to the type of instruction delivery intended (distance vs. on-campus learners) and the types of students using them (mature vs. immature learners)

Changing role of teaching in this environment: While preparing this course, we realized that the role of the instructor in such a course needs to change. For instance, instructors using lectures to anchor the course (as opposed to providing the primary means of instruction) will find themselves playing the roles of:

- Gatherer of knowledge, by the fact that we searched the Internet looking for tutorials in different areas of the course.
- Facilitator, by the fact that we created a resource web page to direct students to the corresponding sites where they were able to collect information and acquire knowledge.
- Mentor, since students asked questions and requested direction regarding the material covered in the course.

Technical

Bandwidth availability: Depending on the material being delivered varying network capacities are required. Some of the students participating in this course were accessing the materials from home using low-end data communication equipment. This sometimes caused their phone connections to drop or slow transmissions.

Site management: The status of links to material contained on other sites must be tracked due to the fact that they are dynamic and can be changed or removed.

Development tools: At the time of this write-up, many of the tools available for the development of Internet-based educational systems lag behind the Web standards. For instance, some products do not yet support frames.

Societal

Copyright protection and other legal issues: There is a temptation to use copyrighted material to supplement the lecturer's own efforts. Use of an electronic means of delivering course material means that implementers can be held liable for any copyright infringement in material placed on their system.

Haves vs. have-nots: At the moment high-speed access to the Internet is facilitated through expensive computational resources. This limits the suitability of systems intended for student's home use.

Phenomenon of isolation: We found that some students had a feeling of isolation when working exclusively from home. Thus, care must be taken to ensure that students are not isolated by the new systems but are encouraged to participate at every possible opportunity in interaction and cooperation.

Student Outcomes

In our initial evaluation, we have experienced that students taking the Internet course have achieved a mastery of course material equal or superior to that in the traditional classroom. Moreover, students have reported higher subjective satisfaction with the Internet course than the traditional courses (TC) on a number of dimensions, including improved overall quality, whereby the student assesses the experience as being "better" than the TC in some way, involving learning more on the whole. Finally, those students who experienced "group learning" in the virtual classroom are most likely to judge the outcomes of on-line courses to be superior to the outcomes of traditional courses.

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Signaling Theory and Internet Epistemology

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Abstract: Since almost anyone can put almost anything on the Internet, there is a lot of *inaccurate* information out there. The standard line is that the only solution to this problem (that does not involve censorship) is for Internet users to improve their critical thinking skills. In this paper, I point out that we can also deal with this problem by making information easier to verify. I then suggest that *signaling theory* can help us to figure out exactly how to make information more verifiable.

1. Inaccurate Information on the Internet

> As access to the Web has widened, legitimate information has been subsumed by a deluge of vanity "home pages," corporate marketing gimmicks and trashy infomercials. ... It is impossible to know where information comes from, who has paid for it, whether it is reliable and whether you will ever be able to find it again. A student looking for information on the Internet about, say, World War II, cannot know whether a given "page" has been posted by a legitimate historian or by a Holocaust revisionist. ([Hecht 1997], p. 15)

There are two factors that make it very difficult for people to acquire knowledge (or at least true belief) using the Internet. First, since there is a vast amount of information on the Internet, it is often difficult for an individual to find the information in which she is interested. Second, once she finds the information, it is often difficult for an individual to determine whether or not the information is accurate. (And since almost anyone can put almost anything on the Internet, there is a lot of inaccurate information out there.)

A lot of effort has recently been put into solving the first problem (e.g., research has been done on improving search engines, classifying information on the Internet, developing automated retrieval systems, etc.). However, the second problem has received much less attention. How can we make it more likely that the users of the Internet will be able to distinguish accurate from inaccurate information?

The standard suggestion is that we have to improve the critical thinking skills of Internet users. Following this suggestion, several recent articles (see, e.g., [Tate & Alexander 1996] and [Fitzgerald 1997]) have tried to identify a number of features that Internet users should look for on a web page. For instance, Internet users are advised to look for a statement of the name and affiliation of the author of the page, the absence of spelling and grammatical errors, the absence of common logical fallacies, etc. Such features are supposed to be fairly reliable indicators of whether or not the information contained on the page is accurate.

Unfortunately, there are two main drawbacks to the aforementioned research. First, these articles have very little to say about exactly why those features that Internet users are supposed look for on a web page are reliable indicators of accuracy. Second, these articles leave the mistaken impression that improving the critical thinking skills of Internet users is the only way to solve our problem. In fact, we can make it more likely that Internet users will be able to distinguish accurate from inaccurate information not just by changing the users (e.g., by improving their critical thinking skills), but *also* by changing the information (e.g., by making it easier to verify).

2. Signaling Theory

There are a number of "signals" that might allow Internet users to distinguish web pages that contain accurate from web pages that contain inaccurate information. However, some of these signals will not be under the control of the authors of web pages. If we want to make information more verifiable, we need to focus on those signals that *are* under the control of the authors. *Signaling theory* (see, e.g., [Spence 1974]) can help with this endeavor. Signaling theory lays out the criteria that such signals must meet in order for them to be reliable

indicators of accuracy. We can then use these criteria to determine if particular signals (such as those identified in [Tate & Alexander 1996] and [Fitzgerald 1997]) do the job.

Signaling theory deals with situations that have a structure similar to the following situation. There are a number of salesmen. Some of these salesmen only sell high-quality products; the other salesmen only sell low-quality products. There is one buyer. The buyer has to decide which salesmen to buy from. He would prefer to purchase only high-quality products. However, he cannot tell the high-quality products from the low-quality products just by looking. (Such situations are *games of asymmetric information*. The buyer is the *uninformed* player and the salesmen are the *informed* players.)

There are a number of different situations that have this structure. The Internet user, for instance, is in a situation that has this structure. There are a vast number of web pages on the Internet. Some of these pages contain accurate information; the rest of them contain inaccurate information. The Internet user would like to believe only accurate information. However, she cannot tell just by looking whether or not the information contained on a web page is accurate.

The buyer needs some way to distinguish the high-quality salesmen from the low-quality salesmen (and the Internet user needs some way to distinguish accurate web pages from inaccurate web pages). *Signaling* can help the buyer to make this distinction. In particular, he can make this distinction if the high-quality salesmen send a signal that (unlike the quality of the products) the buyer can easily observe *and* if the low-quality salesmen do not send the signal.

In order to apply signaling theory to this situation, we make the assumption that the salesmen are more or less rational. In particular, we assume that a salesman will send a signal if and only if the benefit of sending the signal outweighs the cost. Given this assumption, two things have to happen in order for a signal to do the job. First, for the high-quality salesmen, the benefit of sending the signal must outweigh the cost. (In this case, the benefit to a salesman of sending the signal is having the buyer purchase his product.) Second, for the low-quality salesmen, the cost of sending the signal must outweigh the benefit.

Given this analysis, there are some further conclusions that we can draw about the criteria that a signal must meet in order to do the job. First, it must cost something for a low-quality salesman to send the signal. (And it may cost something for a high-quality salesman to send the signal as well.) If signaling were free, then all of the salesmen would send the signal in order to have the buyer purchase their products. Second, if the benefit to a low-quality salesman of selling his product is at least as high as the benefit to a high-quality salesman of selling his product, then it must cost a low-quality salesman more to send the signal than it costs a high-quality salesman. If it costs the same amount for all salesmen to send the signal, then all salesmen would make the same decision about whether or not it is worth sending the signal. In order for a signal to be a reliable indicator of accuracy on the Internet, it must meet these same criteria. For instance, it must cost something for the authors of inaccurate web pages to send the signal *and* it must cost the authors of inaccurate web pages more than it costs the authors of accurate web pages.

Of course, in order to apply these (and other) lessons from signaling theory to the Internet, we again assume that the authors of web pages are more or less rational. However, we also have to assume that (all other things being equal) the authors of web pages prefer to be believed by Internet users. (In this case, the benefit to an author of sending the signal is having the Internet user believe that his information is accurate.) If it does not matter to an author whether or not he is believed, then he has no reason to send a signal that his information is accurate. (It went without saying that salesmen prefer to sell their products.)

Finally, I should note that some signals that are under the control of the authors of web pages do fall outside the scope of signaling theory. In order to do the job, a signal must be something that the author of an inaccurate web page is unlikely to send. In most cases, the author of such a web page is unlikely to send the signal because it is not cost effective. However, in some cases, the author of such a web page is unlikely to send the signal because he is simply unable to do so.

Even so, as I have tried to suggest in this paper, signaling theory can be a very powerful tool if our goal is to make information more verifiable. It provides an analysis of a large and important class of signals that are under the control of the authors of web pages *and* that are reliable indicators of accuracy.

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Navigational Patterns in Interactive Multimedia and Their Effect on Learning

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Abstract
Research on navigational patterns in interactive multimedia outlines previous research and then proposes a new set of navigational patterns from the empirical work, and comparing these to the earlier patterns. Empirical work tested these and assessed differences between novices and experts, and children and adults. Differences in navigation can be explained by factors such as :- how the users have been taught to use software, their usual learning or teaching methods, their exposure to computers and multimedia, their age range and the specific task. Methods of defining and encouraging learning strategies in multimedia are investigated and a usable classification developed. The benefits of multimedia for individuals are outlined e.g. personalised work patterns. The conclusions, state that most users have preferred methods of navigating and learning strategies and these methods, the benefits for the individual learner and the link between navigational patterns, experience and learning strategies are important.

Introduction
The construction of multimedia packages to date has usually been developed along conventional software design. However the unique learning environment which can be created when using multimedia means that innovative methods of constructing packages must be encouraged in order that the facilities and qualities of multimedia can be exploited to give the best learning environments. My research investigates the ways people learn from multimedia, and how we can incorporate these into the design structure. This paper commences with present navigational research, it then investigates the results from the initial empirical work. A new classification for navigational patterns is then outlined and these patterns are then tested by further empirical studies, where the users actual navigational patterns will be analysed in terms of my classifications and these are then compared to those of other researchers. Finally work on learning in multimedia is detailed and some methods of defining and encouraging learning within multimedia are developed, by proposing a series of learning strategies.

Research on navigational patterns
Horney's work (1993) is important here as he investigates users using hypertext and discovers five navigational patterns, namely Linear Traversal, Side Trip, Extended Star and Chaotic. His patterns can be described as :- Linear Traversal where the user visits each nodes in order, moving in a linear pattern; Side Trip which is mainly linear but with visits to other nodes not on their main path and is a more than the first; Star pattern, which uses a central or root and returns to this; Extended star which includes nodes the user wants to revisit, such as out and back cycles and Chaotic where the user has different traversal methods and randomly moves through the document. Horney does not fully explain his star pattern but this appears to differ from his linear one if the user moves to a different level in the package, this is the criteria I have used to determine the difference between linear and star and it seems that Horney had a similar distinction. Horney's view of the chaotic pattern was that these users were not lost, but that their navigational routes were too complex for a more regular pattern to be discerned and therefore the Chaotic pattern could be a mixture of other patterns.

Parunak (1989), also looks at various strategies people use and produces a series of topologies to relate to them. He identifies five common strategies:- Identifier, Path, Direction, Distance, and Address, where the Identifier allows the user to distinguish the target; path follows a definite linear route (and could be a basic component of other more complicated strategies); and direction, such as north. However direction is more of a working method, rather than a distinct pattern. The next strategy, distance limits the search to a distinct circle around the current location and address gives it a specific location. Parunak then briefly develops six topological structures to support these strategies which are - Linear, Hierarchy, Hypercube/ Hypertorus, Directed Acyclic Graph and Arbitrary, which I find much closer to my navigational strategies than are his navigational strategies, which look at methods of navigating rather than at patterns and so I have used his typologies to relate to my navigational patterns. His first linear topology, is straightforward and presents a one-way linear route but it can also form a ring, (as in my circular definition), but if it uses different levels this would be classified as my star pattern, not linear. Parunak's second topology is Hierarchy. The next topology Hypercube/Hypertorus is difficult to relate to multimedia as there are few software packages that would conform to this structure. The next topology is one called DAG - Directed Acylic Graph. My view of this strategy is that it is too similar to the hierarchical one to be categorised separately. The final topology is arbitrary, which consists of any connected graph, this could be a huge category and probably needs subdividing. In Parunak's categories the linear, ring, hierarchical and arbitrary topologies can be broadly compared to my classifications. Having looked at the two main contenders for

navigational patterns I now want to investigate the work of others whose research has influenced my work. Trumbull, Gay and Mazur (1992) experimented with a system which had three different built in navigational and guidance tools :- index, guide and browse. The Index allows the user to search through a textual description of the topics, Browse enables users to use screen commands to move through the package and the Guide provides an online advisor. The three navigation tools were designed to allow users to decide on their own strategies for obtaining information. The results from the survey identified four distinct groups of users, all of whom were classified by using the individual navigational tools for varying amounts of time - Browsers (89% of time), Indexers (65%), Guiders (26%) and Mixers who used all the tools. Hammond and Allinson (1989) also support Trumbull et al's conclusions that as the students were using different strategies, designers should develop a variety of interfaces that allow for different search strategies. Trumbull et al's work is particularly relevant to my research as it looks at the use of particular tools to navigate through multimedia and these tools can be compared to the different ways of approaching an encyclopaedia. Beasley and Vila's (1992) work looked at two main areas, namely the relationship between navigational patterns in multimedia and academic ability, and secondly whether these patterns related to gender. They identified patterns of access in terms of linearity or non-linearity and examined the relationship between these patterns of access and learner aptitude. They stated that females took a less exploratory approach than males, however this appears to be only true for the lower ability female group, while males of higher ability use non linear methods. Mischanuk and Schwier's (1992) work which discusses the use of audit trails in interactive hypermedia is potentially very useful. Their audit trails involve recording each screen that the user visits and factors such as :- the number of repeat visits, how long they spent on certain sections and the exact paths they took, are useful. They suggest four distinct types of audit trails, but state that in reality these are often combined within programs. Their four types are linear, classic feedback loop branching, learner controlled parallel path branching and multimedia/ hypermedia. The first linear is the basic path recognised by several researchers. The second branching structure allows some paths to reconverge, this path resembles my star pattern. Their third structure - branching paths run parallel to one another and converge and the learner then continues on the instructional sequence, rather like my hierarchical one. This final path has the most complex structure and is much more variable than the others. They then give ways of utilising these audit trails :- formative evaluation in instructional design, basic research in instructional design, usage audits and counselling and advising. Hence Mischanchuk and Schwier's results are broadly comparable to mine, except for the fact that they have only found four main types of trails and I believe it is possible to differentiate these patterns into more finite types.

Canter, Rivers and Storrs (1985) looked at user navigation through interactive databases and discovered a set of indices to characterise users search sequences which could give more precise definition of strategies such as browsing, looking at crucial factors such as the task the user is performing and their preferred strategies. They developed six indices to characterise users navigational behaviour:- pathiness, ringiness, loopiness, spikiness, NV/NT and NV/NS. Pathiness describes a route through the data which does not cross any node twice, a typical linear path in my classification. Ringiness, a route through the data which returns to the starting point, is simple and closed, and is like my circular route. Loopiness, is a route in a ring shape which contains no other rings, the main difference from the ring being that the latter usually emanates from a specific base node and is usually the only route from that node. Spikeness is a route which retraces the path taken on the outward journey in exactly the same way and is most like my Star extra pattern. NV/NT is the ratio of number of nodes visited, to the total number of nodes available in the system and gives the proportion used by each individual. Finally Zhao (1992) found that the same type of navigational strategy was adopted by nearly all of his subjects. Zhao describes how he found three types of browsing - hierarchical, depth first search-like and chaotic. He finds that there are a variety of factors which affect the navigational strategy applied by a user such as the hypertext topology, interface design, navigation tools, learning objectives and learner individual differences.

Empirical Work

The empirical work for this study has involved a pilot study of primary and secondary children using multimedia and a main study which looks at the ways adults use multimedia, how they commence using a package, how they navigate through particular routes and how they approach projects. The pilot study used a range of commercially available software, such as The Way Things Work, Grolier's Encyclopaedia and Medieval Realms, among others. The first task involved a short browsing or orientation session, where the pairs of children were allowed relatively free access to the software, followed by a more restrictive set subject that they researched and where their exact routes were recorded and a final task asking them to assess how the material they had been using was structured and if possible to describe or draw the layout. My initial empirical research showed that younger students have very distinct preferences for certain types of multimedia packages, but also that older students were much more task orientated and that they found browsing more difficult and time consuming than the younger ones. These results are also comparable to some of those from Misanchuk and Schwier. Information from the pilot study which is useful to the main study includes the navigational patterns used, the type and nature

of the tasks given to the users, the amount of work possible within the allowed time and problems with recording. This has allowed an analysis of the navigational patterns used, ranging from a simple linear structure through to complex patterns. Furthermore for most users there seems to be either one preferred pattern or a limited range of patterns that they habitually use. However most of these users were new to multimedia and their selection of particular patterns may alter with longer use of such packages, although even more experienced users of multimedia did have preferred patterns of use. In the main study adult students were asked to perform various tasks with a selected multimedia package to assess their navigational patterns and their learning. Both pre and post questionnaires were performed. The pretest questionnaire covers aspects of the students previous computer and multimedia use and their interests. The post test questionnaire asks for some factual responses to specific questions relating to the knowledge they have learnt in the test, and then continues in the form of an interview, where their opinions on the software and their method of navigation are investigated. The following hypotheses will be investigated :- that each individual has preferred methods of using multimedia; that certain navigational patterns are more beneficial to the learning process than others; that navigation patterns can encourage deep learning; that beneficial navigation patterns can be learnt and reused; that experience can improve learning from multimedia; and that controlled use of multimedia can improve learning. Encarta was chosen as the encyclopaedia which allowed the most flexibility and greatest range of navigational patterns, as well having a resource pack which detailed ways of using the package for research and gave templates and instructions to teachers on how to use the package and examples of its use. These are :- an exploratory Task 1, an investigative approach which forms the main sequence of set tasks (Task 2), and a final open task (Task 3). The first task is a browsing task (15 mins) which should allow the individuals personal preferences on navigational patterns and their interests to be determined. The second task is to search for information on a topic in four different conditions. These four navigational routes are linear, circular, hierarchical and complex. The amount of user choice will increase through each of the four patterns. This second task is used to assess navigational patterns, whether or not users keep to the prescribed or flexible routes, how often and in what manner they diverge from these paths, and the learning that is achieved during this time. The third task involves users selecting a topic and researching it within the package for 25 mins.

Results of the main study

From the empirical work in this research it appears that most users have a preferred set of navigation methods. The most popular combination is linear and hierarchical patterns, which appears to be the case across the expert to novice groups, with some users being very linear. These users seem to be very methodical, but as the students who strongly prefer the linear approach are mostly novices this may represent the way they have been taught or the way they usually approach learning, i.e. in a sequential manner, although this may not be the most successful approach with multimedia. Intermediate users proved to be very variable in their preferences, although there were only a few of these, so this may represent the range within the sample rather than the way this group of users would normally perform while the expert users tended to be very complex and this suggests they may have been using certain strategies for certain tasks. The expert users use many other types of routes, some in part, but generally in a more mixed way, showing abilities in switching to different methods or changing their strategy. Most of simpler routes are favoured by novices, the intermediates are slightly more adventurous but it is the experts who on the whole are much more likely to branch out, try different strategies and to follow different navigational patterns for each task. There seems to be a fundamental difference in how inexperienced people choose to navigate, or how they commence using the package and how the experts do this, as their navigation is much less purposely followed, it appears to be much more intuitive, especially if they reach a dead end, when they are much quicker at re-assessing where to go next than the other two groups.

Fig. 1 Main navigation Routes Used (20 Students in all)
Very linear/ little hierarchical - 2 Users (Novices)
Linear and Circular - 1 User (Intermediate)
Linear and Star, some hierarchical - 1 User (Novices); 1 User (Inter)
Linear and Hierarchical - 4 Users (Novices); 1 User (Inter); 4 Users (Experts)
Complex and Hierarchical - 1 User (Inter)
Complex users - 5 Users (Experts)

The linear route is the most common, although not the most frequently used route. Most users need to have some sequential movement through the resource, although this is more noticeable in the novices. There are fewer example of the use of the linear extra route and perhaps this is a variant of the main type rather than a specific route on its own. There are relatively few examples of the circular route in this group of users, although there may be some examples of users using it for small amounts of time. It was much more prevalent in the pilot study as younger users seem to use this, as well as the star pattern, to check that they have covered everything and as an orienteering device, have a quick look around, and come back to the beginning before going on. The star and

star extra are also relatively little used in the adult groups. Most users seem to use the hierarchical or hierarchical extra pattern at some stage during their search, with the possible exception of some of the very linear preference novices. Also some of the children in the pilot study rarely, if ever, used a hierarchical pattern. For most users the use of the hierarchical pattern comes after the initial use of the linear or star pattern, i.e. in the middle of the search. The complex chaotic users are all confined to the expert group and only occur quite rarely. The complex planned type of navigational pattern is the more common of the two types of navigational patterns in this category and is again only used by the experts. The experts were much more competent users and were much faster, covering a lot of ground and making quick decisions. There are several links between the pilot and the main study. Firstly the younger students in the pilot study also had distinct preferences in their choice of navigation routes. Most of the younger students preferred either a linear or a hierarchical route while some of the students also used the star and circular routes. In the main study the linear and hierarchical routes were again most common, although most users used some linear followed by a hierarchical pattern for different stages of the research, rather than the younger students habit of selecting either a linear or a hierarchical route. Few of the pilot study students used several patterns and none were complex users. In the main study there were some users of multiple patterns which became the complex users. The star and circular pattern also seem to be more common with the pilot study students than the main study students.

Development of my own series of navigational patterns

I have developed a series of navigational patterns from the information gained in the initial pilot study. For this research a broad genre of types is sufficient to adequately describe the patterns and to distinguish them from one another, future research may enable further more finite classification. The detailed descriptions of each type follow and are then compared to the types found by other researchers (Fig 2). My list has been created by comparing individual or groups use of multimedia All the users patterns observed could be put into these categories, although obviously there are more in some categories and the latter two categories of complex, chaotic and planned may need further refining as it is possible that these may provide a final classification for all the complex or unusual patterns as well as the very complicated ones.

Description of Navigational Patterns

The following types of navigational pattern have been discerned, with a short description of each :-

1 Linear - Following path on same level, using index, time line, or word search features, usually one way.

2 Linear extra - Mostly as linear pattern but some paths/routes leave this, then return to path.

3 Circular - Initially and in some incomplete forms recognised as linear, when complete can be one way or two way becomes arc or circle when nearer completion, or is dependent on the design of the software.

4 Star - Moving along in linear fashion but changing level, going into all or some second level areas from first level and returning, can be one way or two way, breadth first qualities, going into complete star pattern, selection all through package especially in those with a circular or thematic structure e.g. looked at all themes and moved into second level.

5 Star extra - User goes into 2nd/3rd level of package, i.e.additional level, beyond usual star boundaries.

6 Hierarchical - User moves down hierarchy and then may return to go down one or more other branches of tree structure, usually one way down structure and across or return to next branch of tree structure, depth first qualities, can be two-way, although not usually totally returning to original starting point.

7 Hierarchical - Extra, can go along multiple hierarchies, different subject/ types but all in the same way, can return to same tree structure or may continue onto linked tree structure, i.e. several branches of same tree.

8 Complex - Chaotic, Random use of navigation, may be mixture of some of the above types.

9 Complex - Planned, Sequence of moves following established paths, can usually see which patterns are being used, a mixture of different types but forms ordered route through resource. The types can be mixed within the route, i.e. some recognition of each type but too confused or short to classify as each individual pattern.

Fig. 2 Comparative Navigation patterns

Horney	Zhao	Parunak	Canter	Fenley
Linear	-	Linear	Path (Pathiness) any route not crossing node twice	Linear
Traversal				
Side Trip	-		Loop (Loopiness) ring which contains no other rings	Linear - Extra
Star	-	-		Star
Extended star	-		Spike (Spikiness) retraces path back	Star - Extra
	-	Ring	Ring (Ringiness)	Circular

			Returns to start node, may include other rings	
	Hierarchical	Hierarchical	-	Hierarchical
-	Depth First Search like	DAG	-	Hierarchical - Extra
Chaotic	Chaotic	Arbitrary	-	Complex - Chaotic
		Hypercube/ Hypertorus		Complex - Planned

Comparison of my patterns with other researchers

There are some links between my work and that of the researchers above, especially Horney. There are links with most of his search patterns, although he probably does not extend his classifications far enough. Comparing Parunak's work I can find relatively few links with his strategies, although hi topologies are very relevant and can be linked into my classifications quite neatly. In Trumbull et al's work their Index strategy is like my Star pattern, the Browser suggests the Linear pattern or Horney's Linear Traversal and their guide perhaps - Side Trips or my Linear extra. In Beasley and Vila's work their linear strategy links perhaps to Horney's Linear Traversals or a generalised linear pattern and is similar to my basic linear route, however their non linear pattern is perhaps most similar to Horney's Side Trips, which in Horney's classification system is not really hierarchical, and perhaps slightly to my hierarchical pattern. Hence most of the research has some links to my patterns, but on the whole is less comprehensive and suggests that there are more routes or ways of looking at navigation and most of the researchers have concentrated on quite a narrow range, when compared to my more global approach.

Learning strategy research

The next area of research to be discussed is that of learning cycles which I also investigated, looking at those proposed by Kolb, Driver and Laurillard. The stages in Kolb's (1984) experiential cycle include Experience, Description, Analysis, Generalisation, and Action Plans. Driver's model (1988) covers more of the necessary stages with orientation, elicitation of ideas, restructuring of ideas, clarification and exchange, exposure to conflict situations, construction of new ideas, evaluation, application of ideas, review change in ideas, comparison with previous ideas; but it is a rather linear sequence, whereas Laurillard's has the cyclic process but also includes more reiteration as well as input from the teacher, which she considers to be crucial. Laurillard's cycle (1993), which is perhaps the most applicable to multimedia design, includes stages for both the teacher and the student:- the teachers conception, then the student conception, discussion then the teachers redescription and the students redescription, then reflection and adaption, before more discussion or interaction, then the third part task goal, action, feedback, modified action more interaction follows and the fourth part of the cycle which involves another period of adaption and reflection. Research on the way people learn from multimedia has involved looking at the work of people such as Yildiz and Atkins, Barker and King, and Self.

Yildiz and Atkins (1993) criteria for evaluating multimedia has also been useful to my research as they suggested a whole list of reasonable factors in evaluation which I would support, notably that evaluation should concentrate on courseware characteristics, the user and the learning task rather than the platform; that the software should be exploited to the maximum; that implicit beliefs on student learning methods should inform the design; that the learning context is important and that the evaluation of outcomes, conceptual learning and higher order conceptual skills are essential. Barker and King (1993) suggest the use of self-anchoring where their points of view are anchored graphically or numerically. Their research also highlighted engagement as being highly rated in good multimedia as is tailorability and interactivity, all features which I would agree with. John Self (1995) has been using student modelling with multimedia and in particular stated that 'developers of multimedia learning systems are realising that presentation needs to be adapted for individual learners'. Finally my learning strategies are compared with those of Trumbull, Gay and Mazur; Midoro and Pedemonte; Canter et al; and Conklin. Conklin (1987) states that the browsing of a database can be done in three distinctive ways; by following links, and opening windows successively; by searching all or part of the network and thirdly by navigating around the hyperdocument, using a browser that displays the network graphically. Trumbull, Gay, Mazur (1992) grouped their users according to which of three main navigational tools they use predominantly the Browser, Index, Guide, or a Mixed group. Canter, Rivers and Storrs (1985) work used the type of paths found, e.g. pathiness, but as they also discovered five search strategies to do with ways of learning, their work is also included here. These five strategies are defined as Scanning (mixture of deep spikes and short loops as users seek to cover a large area but without great depth), Browsing (many long loops and a few large rings, users go where data leads until interest is caught), Searching (ever increasing spikes with a few loops for users motivated to find a particular target), Exploring (many different paths, suggesting users are seeking the extent and nature of the field), and Wandering (many rings as the user ambles along).

Description of the learning strategies

From an investigation of this work from other researchers and observations a series of learning strategies have been developed, which can be used singly or in conjunction with the navigational patterns above, these are compared to the other researchers in Fig 3. The use of terms such as browsing is open to abuse as different researchers have applied the term for a whole range of diverse activities and it is more helpful to be more specific as to what each of the activities refers to. Many of these could be attributed to more generalised browsing, and so I have been much more specific in both the naming of the terms and in allocating their use to certain observations. The following list outlines the learning strategies found:-
Orientation, Ordered/ Structured -Linear -Circular, Systematic/Hierarchical, Complex - Random and Complex - Planned. The table below links these with the strategies from other researchers :-

Fig 3 Comparative Learning strategies

Trumbull et al	Conklin	Midoro/Pedem.	Canter	Fenley
Browse	Following links -opening windows	-	Scanning large area -no depth	Orientation delimiting/ quick
Index	Searching the network for string	Topics/Index	Browsing- path to goal achieved	Ordered/ Structured - -Circular
Linear				
Guide	Navigating using Maps network graphically		Searching - find explicit goal	Systematic/ Hierarchical
Mixed	-	Dictionary Anthology - author	Wandering- purposeless, no structure	Complex - Random
-	-	-	Exploring /finding extent of info given	Complex - Planned

There is an element of experience in the use of all search strategies, i.e. does repeated use refine the methods of use and the effectiveness of a particular strategy, or are experienced users likely to develop complex ways of investigating multimedia resources. Frau, Midoro and Pedemonte's (1992) work is very relevant here and can be compared to this study as they concentrate on the modes of interaction and the strategies students use to investigate the software, the problems they encounter using the system and its learning effectiveness. They suggest supervisor functions should be:- the selection of topics to match educational objectives and learner status, choosing the next best topic and the best strategy for that topic, and selecting the best unit of learning (ULM) to both implement the strategy and perform the given educational function. Questions that Frau et al are asked of the students, such as how long do they spend on each activity, what order they proceed in, problems etc, are similar to the questions asked by Laurillard in her student assessment work (1993). Their second aim is to analyse how effective the learning is, an aim which is very close to my own study. They decided on a qualitative approach and assessed different strategies of browsing and the learning that resulted. Interestingly they impose two conditions; a self service mode with no explicit task (similar to my initial browsing task) and task guided navigation, which can be compared to my task based exercises. Frau et al also find that 20% of the time is spent working out how the system worked, understanding and accessing functions, by deductive (looking at system, seeing if appropriate) and inductive methods (using material and then looking for system information). Their results are based on users interviews and the changes in their concept maps and suggest that some students have acquired new knowledge, many others acquiring a lexicon of terms and fewer students understanding the underlying concepts. Looking at the learning strategies, although both groups tended to use some form of linear strategy at some stage in the session the younger students more frequently used the rapid orientation style and less of the ordered strategy, while only some of the pilot group used a hierarchical pattern this was much more common in usage by the main study users. There are also links between the navigational patterns that students use and the learning strategies they use. The experts again have the majority of the links as they tend to use more patterns and strategies generally and are usually able to determine which of these are most suitable for a specific task and use it. The novices are more restricted and will often remain with the one they know rather than try something new. The students that predominately use linear patterns in the navigation are also the most prone to use these, especially the order structure in the way they learn, although there is a small overlap with the hierarchical methods. The experts tend to be more willing to use hierarchical rather than linear learning strategies and link more of the information to outside sources via hot text. There again seems to be some individual preference for particular learning strategies, although this is not as strong a preferences (or set of preferences) as in the navigational patterns. However there is less of a link between the navigational patterns and the learning strategies used in the pilot study than in the main study.

Conclusions

The main element of this research has been exploring the navigational patterns that users employ. External factors may have an effect, such as:- how the users have been taught software, their usual learning or teaching methods, their exposure to computer and multimedia, their age range and the task they have been given. The findings of the research suggest that each student has their own individual preferences in how they navigate through software and how they approach learning from it. If we are to encourage students to construct their own learning environments in the constructivist sense then we must encourage them to develop their skills on directing their own learning and in becoming aware of methods of increasing or improving learning, in other words allow them to develop themselves but give them the skills and abilities to be able to do this. If motivation is increased and students can select their own options this deep approach should allow the potential of each individual to be reached. Multimedia can enhance this process by allowing students to develop themselves and providing individual help angled for that particular student and given to them, both in terms of instruction and content as well as help, in the way they prefer and in the manner in which they are likely to gain the most from it. The main empirical work has shown the benefits of multimedia for individuals such as allowing a personalised pattern of work and being able to progress at their own pace. The results of the main empirical work help to support some of these factors and the hypotheses and create some more definable links between navigational patterns and learning in multimedia.

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Using a Recommender System and Hyperwave Attributes to Augment an Electronic Resource Library

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Abstract: There has been increasing interest over the past few years in systems that help users exchange recommendations about web documents. Programs have ranged from those that rely totally on user pre-selection, to others that are based on artificial intelligence. We propose a system that falls between these two extremes, which has distinct advantages over other existing systems since it utilises the structure and attributes associated with Hyperwave documents. This recommender system, which also ensures integrity of external links through its underlying server environment, can enhance the knowledge base of learning associations and other intranet groups.

1 Introduction

Online recommender systems are a relatively new idea, although several innovative projects were described in detail within a special issue of Communications of the ACM [Communications, 1997]. They offer a shared knowledge base of empowerment for online collaboration; to which our intended development adds several unique features. In addition to generating personalised pages of new recommendations, the system will provide users with a historical record of their past and present recommendations to search, review, or rearrange. Each user will be able to review the results of their own archive, but since the recommendation links are to be stored in Hyperwave's structured database, users can also browse and query an anonymous display of an entire group's online history of selective media collaboration. This shared resource can be 'seeded' with a carefully selected set of links at the time a group of some kind is formed, giving new users a basis upon which to begin interacting.

Since this system relies heavily on certain characteristics of the Hyperwave server (developed by Professor Hermann Maurer and his colleagues in Graz, Austria) we will describe these capabilities briefly in Section 2.

1.1 The Context of the Project

The recommender system we describe here evolved from the more general concept of a system that would produce a personalised electronic 'newspaper' for members of the web community at large [Fenn & Shearer, 1996]. In this study we focus on tighter-knit communities such as those in intranet contexts, e.g., those in banking consortiums, medical groups, and education systems.

1.2 User Participation

Our initial approach assumes that all members of the participating group(s) have the same basic aims and objectives, with strong personal incentives toward collaborative cooperation. This ensures that users are sufficiently motivated to quite regularly pass on recommendations for the good of the group as a whole.

2 Hyperwave

It is appropriate to include a brief summary of some of Hyperwave's main features, as these relate to the capabilities of the recommender system that we describe here. More detailed information can be obtained in both book form [Maurer, 1996] and online [http://www.iicm.edu/hw_mm].

Hyperwave was designed and developed as a document management system for very large quantities of multimedia data that can be spread over multiple remote servers. Since efficient maintenance of such massive collections of data is a critical issue, a structured approach was pursued right from the beginning (of what was originally called Hyper-G) [Andrews et al., 1994, Andrews et al., 1995, Flohr, 1995].

The Hyperwave server consists of a set of object-oriented databases. Hence, it supports a range of useful features such as assigning attributes to objects, full-text indexing, and searching (which, in this case, can be confined to a limited scope). The server also maintains a hierarchy of user and group identities.

A variety of attributes can be assigned to each document:

- Multiple, searchable keywords
- Language (with support for multilingual clusters)
- Display properties; such as sequence within a hierarchy
- Read and write permissions for both groups and individuals
- Direct debit, from the user's account, of the cost of viewing a document
- Setting of a time period during which the document is visible to other users
- Any other custom or system-specific attributes

Since attributes are not stored within the documents themselves (as is the case with most web servers), but in a separate database, they can be very efficiently managed, searched, and redefined. Even hyperlinks have attributes.

Each object is labeled with a globally unique object identifier that allows unambiguous referencing from every Hyperwave server. Since these identifiers will not be re-used when the document is replaced or deleted, remote Hyperwave objects can be cached without requiring a sophisticated cache update protocol.

Another aspect of Hyperwave allows multiple servers to be organised into a 'server pool' that shares a common user-hierarchy and keeps the distributed data consistent within the pool (e.g., within a corporate intranet). The Hyperwave protocol is session oriented and stores status details ('session information') about every user currently connected to the system, which can help facilitate various real-time user-to-user communication possibilities.

3 A Simple Recommender System (SRS)

At the University of Auckland's HyperMedia Unit we are prototyping what we term a Simple Recommender System (SRS), based on the fact that we as humans are inclined to express opinions about things. As mentioned in Section 1, the system that we are developing also rests on the assumption that people in a closely collaborating group will actively make recommendations to each other - provided it is reasonably easy to do so. SRS requires that group members use a Shockwave- or Java-enhanced web browser, and that they are logged on to the Unit's local Hyperwave system.

The enhanced browser window will enable users to easily make evaluated and recipient-list-directed recommendations about the currently active page (see Section 3.2). The system will then incorporate all of these recommendation into an interlinked database of URLs, in such a way that each individual user's view is

completely customised on the basis of their own past interaction with both online resources and the rest of the collaborating group.

An absolutely critical aspect of this overall scheme is an intuitive means for users to provide feedback about the accuracy of any recommendations coming through the system, essentially to 'vote' on the relevance of each media resource encountered. This gives the local assessment database a means to adapt its 'rating' of each referee in terms of their success at tagging appropriate resources, from the point of view of the recipient.

3.1 Client-Server Arrangements

3.1.1 Server-side Considerations

On a Hyperwave server the group administrator initialises the SRS by setting up an appropriate collection structure that reflects primary categories of interest to the group. The administrator may also 'seed' the initial collection with URLs of introductory material needed by new users. We'll use Hyperwave's attributes to first prioritise those documents which we consider to be 'core' content; e.g., any documents about using the system itself that new group members should read before beginning to look at other users' recommendations.

In the background will be the software machinery that manages the user-database and meta-collection of recommended links. This can be configured to recognise identical links, having been input by different users, and accept only one numerical evaluation of any particular link from each individual user. Each user can later return at any time, however, to revise their 'value judgment' about a specific online resource. On a regular basis the system will perform a simple statistical analysis of the cumulative assessment of each link and holds the result as a 'group' evaluation attribute. This 'democratically' averaged evaluation can then be viewed within a user's browser interface, whenever they access that resource.

The most critical aspect of the system will be the database analysis functionality that keeps track of the complex pattern of evaluation and interaction between users. It is beyond the scope of this paper to describe the technical details of this process - other than to mention that any resource assumes a relatively higher value within an individual user's own index if it has been specifically recommended, rather than just personally evaluated at the same numerical level. Thus any interpersonal action is rated higher than the same isolated system event.

3.1.2 Client-side Considerations

All of this depends, of course, on users having an effective means of interacting with the background system. To the greatest extent possible, the design of the interface and patterns of interaction must be determined by the needs of end users, rather than by the constraints of any particular suite of software. We have therefore chosen to approaching the production of the client components of the system along two parallel avenues of development: Shockwave and Java.

Shockwave documents are the runtime versions produced from Macromedia's 'Director' application, which require a plug-in to function within a browser. Director is one of the most versatile high-level authoring tools for interactive media, while its underlying language 'Lingo' allows for a reasonable amount of customised programming. As such, initial development with Director/Lingo provides a rapid prototyping environment for implementing various possible forms of SRS client appearance and functionality.

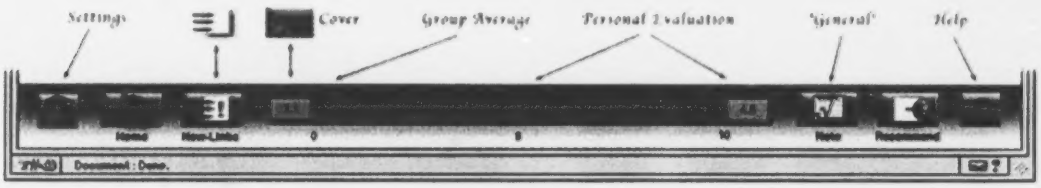
Java, on the other hand, offers the attraction of being able to interlink much more closely with the operation of a web browser and thus more easily access the full capabilities of Hyperwave. This carries the cost however of a longer development cycle and (at present) considerably less assurance of reliable operation on varied systems, compared to an implementation based on a proprietary plug-in.

These two lines of development are not really so separate, since Macromedia is working to position Director as a higher-level programming tool for Java, as well as for its own proprietary formats. Unfortunately, however, the Java output from the current 6.5 version of Director is not yet capable of handling the tasks that are normally delegated to 'helper' components, termed 'Xtras', in the native Director environment. While the functionality provided by these Xtras is not absolutely essential to our initial recommender system, it does

constrain the design to rely only on those network activities that can be delegated to a normal web browser. This seems an acceptable trade-off at this alpha stage of development, though, as a means to readily implement a variety of different approaches to determine the most effective design for the system's basic interface and user interaction.

3.2 Making Recommendations

One of the most important considerations in the design of the SRS is that it should be as easy as possible to make recommendations. Whenever a group member logs onto the group's site, using a Shockwave or Java-enhanced browser, they will see a new-recommendation page (described in Section 3.3.1) along with a specialised interactive options bar as shown in the 'screenshot' below:



The browser-based options bar has the following features (viewed left to right):

- A 'Settings' button which lets each user customise their interface as well as their personal relationship to the overall system.
- A 'Home' button. Clicking on this takes the user to their Home collection archive which serves to index all previously followed recommendations, on a prioritised basis, as well as holding links to that user's own files on the server.
- A 'New Links' button, showing an exclamation point if any fairly highly-valued fresh links are available, which will then bring up an automatically-structured display of all recommendations that have been received since the last (cf. Section 3.3.1), or appears greyed-out if there are no fresh links.
- A central 'Value' slider for entering a personal value judgement about the resource currently displayed. In the case of any document that is new to the user, this slider is preset to a middle value for an 'average' recommendation. (Note that the number scale could be set by each user, to suit their preference for 'granularity' of assessment, and then cross-calibrated at the server.)
- The 'Group' summary field. This is initially a closed window that the user can click to open, revealing the mean value of all evaluations of the current document by other users. This policy of initial concealment was chosen as a way to encourage users to make their own independent evaluations, before effectively polling the average judgment of the whole group.
- A 'General' notation button that sends the URL of the current document to the user's own archive – as well as the group collection - with a value, but without choosing a category for it or designating any specifically defined subset of recipients.
- A 'Specific' recommendation button. On clicking this button the user is provided with a separate interface window wherein they can define the category, user group, and even individual user name(s) for this particular recommendation.
- A 'Help' button, offering context-dependent information about the system.

3.3 Receiving Recommendations

Although the core functionality of the SRS will rely primarily on graded recommendations made directly by users of the system, there are other interesting possibilities. For example, the system can be extended to match up user profiles (based upon their detailed history as evaluators) and then make its 'own' prioritised

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recommendations. This effectively serves to create identified but 'virtual' referees (based on an automated analysis of users with similar profiles, who have not otherwise specifically exchanged links that appear to be relevant to each other). This is the general sort of recommendation strategy employed by the Firefly system [http://www.firefly.net]

As described in the next three sections, group members will have several different ways of viewing the recommendations that they've received:

3.3.1 The New Links Display

The New Links 'page' will display the recommended URLs as a list sorted on the basis of an analysis of the referral scores for each individual link. The system enables this page to be personalised on the basis of several interrelated factors. For a start, some users may choose to receive only recommendations that fall into their own selected categories. The display graphics themselves can be selected to suit their own representational choices. Then they can adjust the bias of the system's calculations, giving more or less weight to recommendations that come from any other identified user. Finally, they can specify the degree to which they want the system to adaptively readjust the weighting of each referee's new submissions, based on their own history of evaluated reactions to all of that person's previous recommendations.

Just how the New Links page is presented can also vary widely. Although our initial SRS design only displays a sorted list of URLs, a later version of the system will dynamically create a customised newspaper-like HTML document. This can include banner headlines, re-sized graphics, and selected sections of text - all automatically laid out on the basis of the same underlying sorted-list functionality [Fenn & Shearer, 1996].

3.3.2 The User's Home Collection of Recommendations

In a Hyperwave environment, each identified user has a Home collection that is their personal document space, to which they have both read and write access. Within our recommendation system, the server itself can automatically write to this collection, creating and updating a prioritised index of all the recommendations previously followed or freshly introduced by that user.

In the SRS, these collections and links are to be displayed simply as hierarchies within a browser window. However, we believe that ultimately the system could benefit greatly from having an alternate mode of access to this Home data, including a suite of specialised interaction tools, for the manipulation of data where *time*, rather than space, is the essential coordinate. The Lifestreams concept, originally conceived at Yale University, makes very compelling arguments for the further development of such a temporal interface metaphor [http://www.lifestreams.com].

3.3.3 Browsing and Querying the Group Collection

The link to this shared view of all recommended links is to be found at the top of each individual user's Home collection. In essence, it is managed by the system in much the same way as each individual's Home archive of SRS links, except that in this case the evaluation criteria is the averaged judgment of the group as a whole and the structure is maintained by the system administrator. New users in particular may find it useful to be able to browse the structured collections containing past years' recommendations. In addition, all users can query this group database using the Verity search engine that is built into Hyperwave.

4 Maintaining Referential Integrity within a Library of Recommendations

The archive of recommendations can form a most valuable resource library and will become an important part of the group's knowledge base, but one of the most difficult aspects of electronic library maintenance is that of ensuring the referential integrity of the links themselves. Within any really useful system these links can number in the hundreds of thousands and it is not humanly possible for any webmaster to maintain them all. Fortunately Hyperwave, as mentioned in Section 2, maintains the link integrity of all documents stored on a 'pool' of Hyperwave servers [Kappe, 1995]. For links to URLs on conventional web servers, the HyperMedia Unit has developed a program to regularly check these external documents, notify interested parties of any

changes, and supply at least the text of any missing documents from a local cache [Anderson and Lennon, 1998].

5 Conclusion

The system we have described will help to establish a shared knowledge base by way of recommendations provided by participants in online group collaboration. The process relies on identified users who intentionally classify URLs, but then employs a database of past activity and an automated evaluation meta-structure to manage the weighted distribution of recommendations. It can thus effectively track and 'learn' each user's preferences for online media by giving individual documents particular priority with respect to the judgment of other referees - without having to rely on any high-powered AI capabilities. We believe that the further development of this approach to collaborative filtering will yield systems (and related service offerings) of very widespread usefulness - particularly within dedicated intranet settings.

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Integrating Web Information Sources

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Abstract: When researching a topic, users often need different kinds of information which are provided by different information sources. In developing the SINGLESOURCE application, we are building a framework for accessing multiple sources, both for querying several sources simultaneously and viewing the results in a hierarchy of related documents. We first discuss our approach to querying multiple sources, including query translation and result parsing. We then describe our strategy for classifying documents and displaying documents within a taxonomy.

1. The Problem

One of the Web's great strengths is its diversity: one can find information on almost any topic, from many different sources. However, people often want to combine data from multiple sources in a sensible way. For example, someone studying Asian cooking might want information on specialty stores that stock exotic ingredients, recipes and a discussion of regional differences in Asian cuisine. Finding different kinds of information often requires combining results from many different information sources. A user must identify promising sources, and then submit queries to each source. Next, each search request must be recast in the query language of each source. Having gathered results from many sources, the user must often organize the results in a meaningful way, grouping related results by category rather than by information source. At Northwestern University's Intelligent Information Laboratory (the InfoLab), we are currently developing the SINGLESOURCE system to research these and related issues.

2. Accessing Multiple Information Sources

As mentioned above, certain web searches are difficult because they require reformulating queries for different search engines, and the results are difficult to categorize. SINGLESOURCE is designed to address these problems in two ways: a unified query interface and a document classifier. Through the SINGLESOURCE query interface, users enter a single query, and then choose which information sources will be queried. (In SINGLESOURCE, an *information source* is a search engine, plus a description of the accessed data, including the content and structure. For example, the AltaVista Web search engine is an information source, as is the *New York Times* on the Web and Lexis-Nexis. With indexing and retrieval software, such as Verity's Search '97 SDK, custom information sources can be created from existing documents.)

2.1. Looking for Information?

The SINGLESOURCE interface enables users to enter a single search query, and choose the information sources to search. (See [Fig. 1] for a view of the Boolean menu query interface.) There are three styles for entering search queries: complex Boolean, Boolean menu (shown in [Fig. 1]) and free text. (The free text query style allows users to enter plain text to be used in a query-by-example search.) The user only needs to enter the query once, and choose the desired information sources. The sources are chosen using the *Search Where?* Section, shown on the right-hand side of [Fig. 1].

After the user clicks the *Search!* button, SINGLESOURCE will send the query string to each of the checked sources. Within the program, each source is represented by an *information adapter*. The adapters are objects (in the object-oriented programming sense) that encapsulate the information needed to submit a query, and parse the returned results. Each adapter must translate between the SINGLESOURCE query language (a garden-variety Boolean query language) and the specific language of the represented source. Although the syntax of many

Boolean-style languages is quite similar, different features are available for different sources. For example, some sources allow proximity searches that enable searches like: find "relevance" within six words of the phrase "information retrieval". The SINGLESOURCE query interface supports proximity searches, but not all information sources do. Thus, the information adapters must "translate" a proximity query into a reasonable approximation. For example, a proximity search might be treated as a simple conjunction:

```
relevance WN 6 "information retrieval"
```

could be translated to:

```
relevance AND "information retrieval"
```

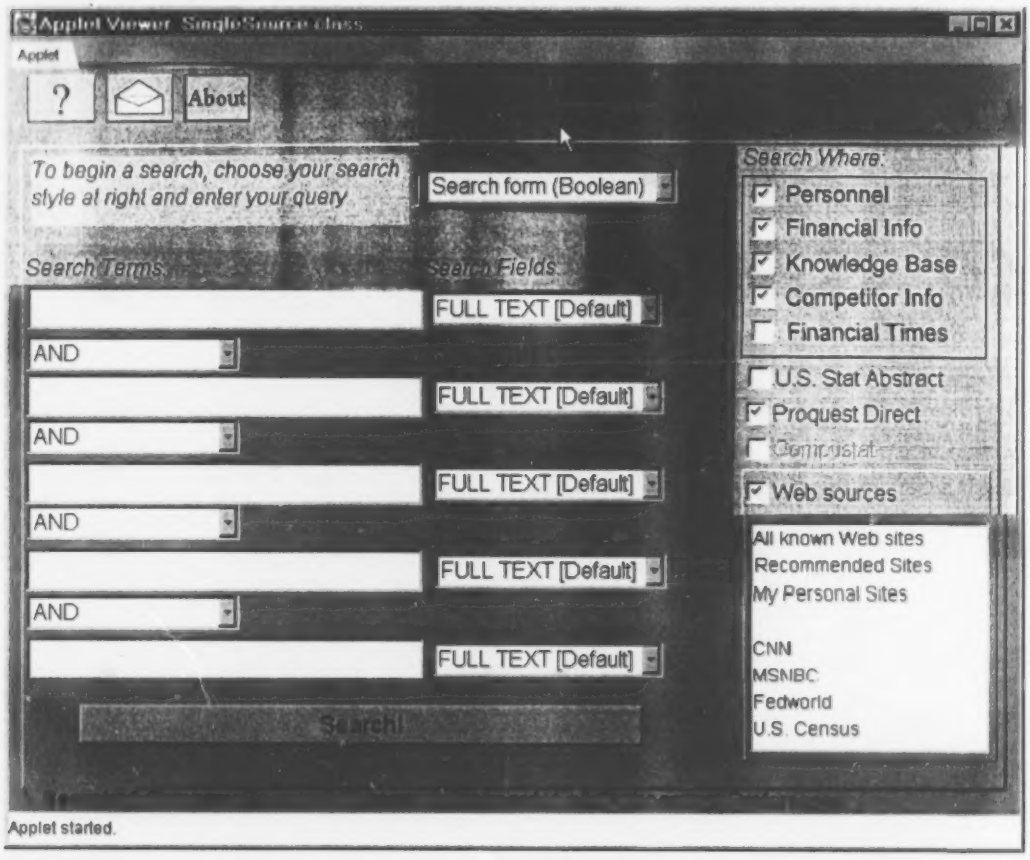

Figure 1: The SINGLESOURCE Search interface, using the Boolean menu query mode

One research issue we are currently addressing is the design of an information source description language. Each information adapter would then include meta-information on the facilities of the underlying search engine, for example whether or not an engine supports proximity searches and the syntax of such searches would be represented in the source description. Then, the SINGLESOURCE could use more general transformation rules, coupled with a source description, to create source-specific queries dynamically. The W3C is actively developing standardized approaches to representing meta-information, including the new Resource Description Format (RDF) [Lassila and Swick (1998)]. RDF (which is based on the eXtensible Markup Language, XML) is a convenient representation language designed specifically for describing metadata and a likely format for our description language. Information adapters must do more than just transform queries though — they must also parse the query results.

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2.2. "A chicken in every pot, and a format for every search engine"

Once a user's query has been sent to each of the information adapters, and they in turn have queried the underlying search engines, the returned results must be transformed into a common format. (The common format is needed because the results will be classified before being displayed for the user, and the classified results will be displayed with a consistent view. The classification and display of results are discussed in [Classification and Display of Results].) Each information adapter encodes a description of the underlying result format, and methods to extract needed data from the result display format. A comparison of search results between AltaVista and Infoseek is shown in [Tab. 1].[1] Although the two formats look very similar to the human eye, they are quite different to the untrained computer.

Despite the difference in formats, the information included in the results from the two sources is quite similar. Both results sets include: a title, date, size and location (here, a URL). SINGLESOURCE needs to read the different result formats, and represent the information for each result in a common format. The sequence of results from a query to particular information source is given as a result list. Individual results can be accessed either by asking for the nth result, or through successive calls to a `getNextResult()` procedure. Accessing a result returns a result object, which can in turn be asked for more detailed information. For example, the method `getDocumentDate()` returns date information for a result.

AltaVista	*Infoseek*
About **777** matches were found.	[redacted] Hide summaries | Click Ungroup to see all results | next 10
1. Stylistic Variation in an Information Retrieval Experiment [**URL:** www.cs.nyu.edu/cs/projects/proteus/karlg...p/nemlap10.html] Covariation of Genres and Relevance. Results. The genres are of differing utility: some genres contain more good items than others. Discriminating between. Last modified 13-Sep-96 - page size 635 bytes - in English [Translate]	**Supporting Interactive Information Retrieval Through Relevance Feedback** Center for Cognitive Science Rutgers University Frelinghuysen Rd. Piscataway, NJ 08855 USA +1 908 445 6122 koeneman@ruccs.rutgers.edu I investigated the interactive searching behavior of two groups of subjects using a novel best-match, ... **80%** http://www.acm.org/sigchi/chi96/Doctor-Consort/koenemann/jk2_txt1.htm (Size 11.4K) Document Date: 22 Aug 1998 Grouped results from http://www.acm.org
2. Infomationsmethodik III (WS96/97) [**URL:** www.iud.fh-darmstadt.de/iud/wwwmeth/lv/ws96/im3/prot1.htm] Fachhochschule Darmstadt; Fachbereich IuD; Informationsmethodik; Lehrinhalt; Lehrveranstaltung; Hauptstudium; Protokoll; WS96/97; Dokument_in_Bearbeitung.. Last modified 22-Jul-97 - page size 72K - in German [Translate]	**Glasgow FERMI - Technical Reports** FERMI Technical Reports:. The following is a list of technical reports published under the FERMI technical reports series: FERMI 1-94 Fabio Crestani and Keith van Rijsbergen - Information Retrieval by ... **75%** http://www.dcs.gla.ac.uk/fermi/tech_reports/ (Size 5.6K) Document Date: 22 May 1997 Grouped results from http://www.dcs.gla.ac.uk

Table 1: Comparison of AltaVista and Infoseek Result Formats

[1] Both Web search engines support different display formats — the two shown here are the default formats.

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3. Classification and Display of Results

Although searching multiple sources can yield better search results, the user must collate the results from all the accessed sources. For example, when searching for Asian cooking information, you might use your favorite Web search engine, but you might also try more specific search engines on the Web, such as: Asian American Cooking Exchange, OrientalFood.com and Kosher Asian Recipes. Once you've located the search interface to each of these sites (or indexed the pages locally) and entered a search, you would still have a list of results for each site without any overall organization. In the SINGLESOURCE application we are building tools that categorize documents given a taxonomy. (A *taxonomy* is a classification of objects and their relations. A well-known taxonomy is the division of living things into kingdom, phylum, class, order and so on. In this case, the relation represented is inheritance, or "*is-a*". See [Fig. 2] for a portion of a business-related taxonomy).

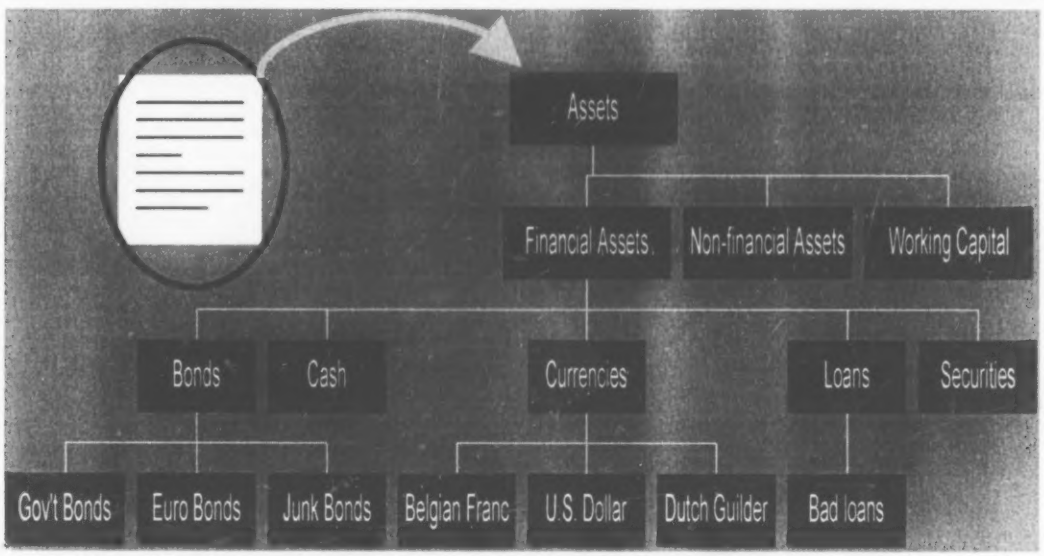

Figure 2: Classifying a document given a taxonomy

The system begins with a taxonomy and a set of pre-classified documents. SINGLESOURCE is then trained with the exemplar documents; at compile-time, a discrimination network [Feigenbaum 1963] is built using these documents. (Currently, the system only supports a single taxonomy, but the design makes it easy to add alternative taxonomies, and perhaps to allow end-users to choose the taxonomy to be used for classification.) At retrieval time, the system collates the results by retrieving results from each of the requested sources, which are given in the common result format. Next, the result documents are classified using the previously constructed discrimination network. The classified results are then embedded in a tree structure based on the underlying taxonomy. The user can then browse through the result using the tree structure, as shown in [Fig. 3]. As a user clicks on a class or document while browsing the tree, information on the class (or document) is displayed on the right-hand side of the window. When a document is selected, the user can view the document in a separate browser window by clicking the *View Document* button.

4. Conclusion

The SINGLESOURCE application is a research framework, but one addressing a very practical problem. As online information sources proliferate, users can benefit from better targeted, and perhaps more accurate, sources. However, retrieving results from many different sources can be difficult both when entering queries and when making sense of results. Our initial results suggest that the approach outlined here is promising, and that users see it as a substantial improvement over current usage. In the future we plan on refining the classification procedure and building a description language for information sources that captures both their syntax and content.

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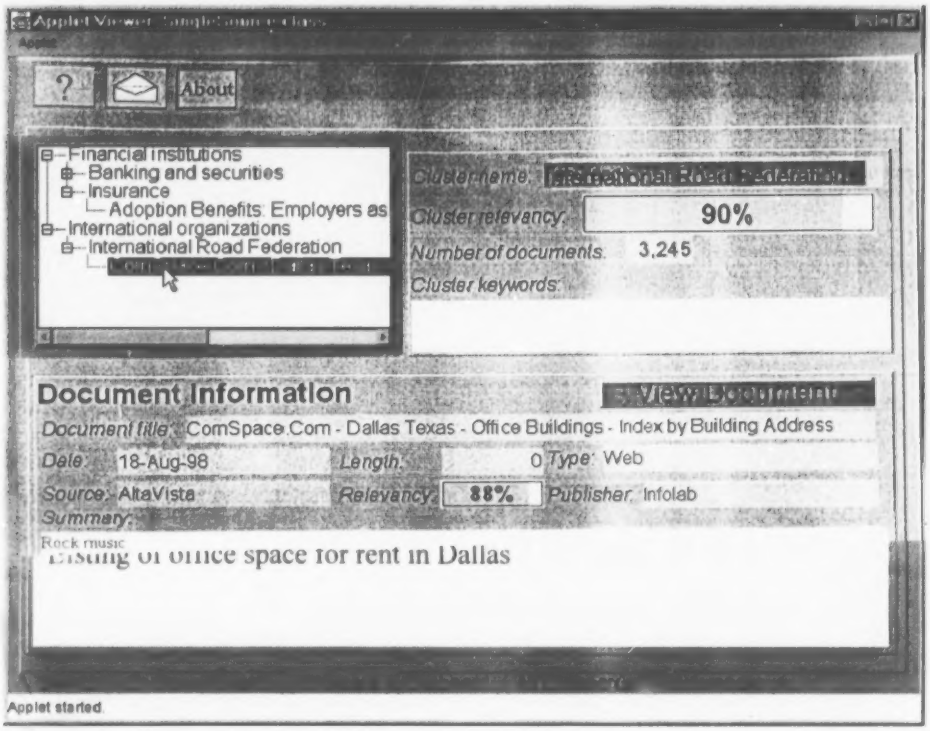

Figure 3: Display of search results in a tree format, based on a business-oriented taxonomy

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Reading Classroom Explorer: Video streaming models of excellence

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Abstract

Emerging video streaming technologies, although still considered bleeding-edge, present many new opportunities for more than just businesses on the web. They provide a new medium for teaching and learning among educators and their students. When considering the role of streaming video and audio in education, one commonly thinks of distance learning and telecommunications which provide greater access to available educational resources. We believe that the full potential of streaming technologies goes beyond the simple, although quite important, characteristic of increased access. The purpose of this paper is twofold: (1) to highlight the benefit of web-based video, as we see it: it provides models of excellence--an approach in which network-based learning environments and video streaming can be combined to broaden students' educative experiences; and (2) to document and analyze the Reading Classroom Explorer as a case study of such an approach to education and uses of these new technologies.

Teacher Education

Many new opportunities have been created in education with the introduction of video and audio streaming technologies. One of these opportunities has been called distance learning/telecommunications. Educators who teach "on the web" embed pictures, graphs, and sounds to support and extend their content-area information, often in hopes that their points become clearer. Like these educators, we also view student access to video as a power of the web medium. In the domain of teacher education, this is especially valuable. Instructors have the flexibility to offer preservice teachers video images of teaching. Current research (Authors, 1998) indicated that some preservice teachers evidenced frustrations and disappointment with their collaborating teacher's classrooms, stating that their collaborating teachers did not use the innovative instructional techniques that they were learning about in their course. With video images in The Reading Classroom Explorer, they received a chance to see what great teaching could be like, in action. The access to many models of teaching was encouraging to them, and was vital to preservice teachers who were especially frustrated by what they considered to be non-progressive teaching methods espoused by their collaborating teacher.

In the past, using video on the web required viewers to download the video (i.e., wait until the computer received it in its entirety) before the user could watch the video excerpt. These download times, often up to a half-hour, reduce its applicability to time-sensitive educational courses. Video streaming offers users a few seconds of download time afterwhich the video begins to play on their screen, buffering the rest as the video proceeds. Only now, with the development of video streaming capabilities, has video and web-based learning environments become feasible for implementation in educational settings.

We now offer the Reading Classroom Explorer as an example of a project which uses video-streaming in an educational context.

Reading Classroom Explorer

In an attempt to engage preservice teachers as actively as possible in classrooms in which they can see teachers exercising their craft with a wide array of culturally and intellectually diverse students, we developed The Reading Classroom Explorer, a hypermedia tool for teacher education. The Explorer is a hypermedia learning environment containing about 200 video clip excerpts of the Center for the Study of Reading "Teaching Reading: Strategies from Successful Classrooms" series of video tapes (documenting six diverse classrooms), as well as video transcripts, questions for further thinking, reference citations for further research, and an interactive notebook. We not only wanted to transport students to these classrooms, which we could already do via videotape, to see the diversity in action, but we wanted to allow them to visit, revisit, analyze, critique, compare, and contrast a set of diverse classrooms in the rich, flexible, and idiosyncratic manner that hypermedia might provide. The many different types of media from many classrooms combined in an environment in which the user has a significant amount of control over the delivery of the media may broaden teachers' knowledge of teaching reading and expand their repertoire of experiences from which they form a teaching philosophy. Further, using RCE could also serve as a stepping stone to help teachers learn to use hypermedia environments and increase their comfort level using other technologies.

Reading Classroom Explorer focuses on preservice teachers as the intended audience. However, our research (Authors, 1998) also indicates that RCE may be very attractive to and have benefits for practicing teachers as well. Student interns report that access to these six teachers' practice after beginning their first teaching position would be invaluable. In addition, interns desired the opportunity to "visit" the six classrooms with their collaborating teachers. Such an experience would provide common ground for more discussions about multiple models of the teaching and learning of reading.

Implications

There are benefits of using video streaming as a means to distance educate. In the case of Reading Classroom Explorer, the most important feature is the control the student is given over the medium regardless of where they are located. The student has the opportunity to not only critically analyze video of classroom situations, she also may consider these images of excellent teaching when developing her own philosophy of pedagogy.

As a part of a network-based learning environment, video streaming can indeed become a powerful tool. Our database tracks the students' progress through the videos and allows her to see what topics she has discovered and re-access her notes while watching the segments. RCE poses questions for users. Users not only can thoughtfully consider the questions on their own (which then becomes part of the database) but they can also access other users' opinions through the RCE chatroom or the database of others' answers (which grows as use increases).

In sum, students of network-based learning environments which incorporate video streaming are able to categorize and recognize exemplar models of instruction, and areable to further develop their own philosophies of pedagogy with consultation of these models. It is also possible that experienced teachers who use the Reading Classroom Explorer may find new ways of teaching or reflect on their own practice. This case study of the Reading Classroom Explorer, an interactive learning environment which uses video-streaming in a distance learning context, provides effective models of excellence for students at any distance. These users can critically analyze models that, without access to RCE, they may never have had the opportunity to view. This offers one way to harnass the power of streaming technologies on the web for the benefit of education.

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TIGER: The web as a site to examine decision-making processes

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In 1997, a large association in education took a giant step towards integrating technology into its organization with the induction of Tiger--a web-based electronic proposal-processing system. The system allowed users to submit proposals via email or the web, reviewers the ability to review on-line, and program chairs the opportunity to reject, accept, and organize the submitted proposals--all within the click of a button. Because all of the divisions using Tiger accessed the same database, researchers had the unique opportunity to look at some of the behind-the-scene activities surrounding the acceptance and rejection of proposals for that. This availability of data provided a lens to examine some of the underlying assumptions about the organization and its processes. The purpose of this paper is to provide evidence through actuarial analysis that those underlying assumptions are not only false, but may in fact be dangerous in blinding members to the needs and trends that have arisen as part of the evolution of the institution.

Using NetShow for Development of Information Technology Modules

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Abstract: A series of information technology skills modules is under development to address the needs of students, faculty, and staff for information literacy skills. The modules will be delivered via the Internet and CD-ROM. They involve the use of audio synchronized with corresponding screen captures, and web pages. Online quizzes are provided via a JavaScript application and a Perl program. The products were developed to work on both Macintosh and IBM computers, and will work with Netscape or IE browsers. Microsoft's FrontPage software and RealPublisher were used in the development process.

Overview

The Information Technology Skills modules will be utilized to train faculty, staff, and students in essential skills related to search, retrieval, evaluation, and presentation of information. Students of every major must be competent in handling electronic information. This proposal lays the foundation for development of a 1-credit, self-paced course for freshmen and new students which gives them skills vital to every graduate. The self-paced components of the module will also be used in faculty/staff training. To date, three modules are complete. The modules utilize audio synchronized with screen captures and web pages. Two products were utilized to develop the modules – NetShow and RealPublisher. In addition, scripting for online quizzes was developed in JavaScript and Perl.

Information Literacy Skills

The list of information literacy skills to be delivered in the modules includes Searching Library Databases, Using Online Library Catalogs (WebPals), Internet Search Techniques (Parts I and II), Computer Viruses, Internet Privacy Issues, Citation and Assessment of Electronic Materials, Data Entry, Retrieval, Evaluation and Presentation using Microsoft Excel, Copyright and Fair Use Issues for Electronic Media, Organization of Electronic Materials, Electronic Discussion Groups -- Listservs, WebBoard, and Presentation Tools -- PowerPoint and Web-Based Presentations.

Module Development Process

The process of developing the modules started with organization of the content, which was of utmost importance. A script for the audio was developed, outlines for the material were designed, and appropriate screen images were captured to correspond with the audio. For the first module ("Searching Library Databases"), six lessons were developed, each approximately 15 minutes in length. Quizzes were also developed which provide immediate feedback on the number of correct responses as well as the correct answers. JavaScript was used to design the tool for interactive quizzes on the CD-ROM. A Perl script was used for the Internet version.

While the content was being organized and developed by the content, members of the Student Technology Team worked on the design of the interface for the web materials. A frame-based introductory page was

utilized in all modules. The left side of the screen lists available lessons while the upper part of the screen contains audio controls.

Next, the audio recording was done, using the scripts provided by the content specialists. Students worked with the various codecs (compression / decompression) to decide on an appropriate choice. Factors involved in the decision included the need to deliver the content in two ways (via the Internet, where most users would have access to a 28.8 modem or better, and via CD-ROM) as well as an acceptable quality.

Finally, NetShow and RealPublisher software was utilized to create the final layout for the module. Timing information was entered so that the screen images and web pages corresponded to the audio appropriately.

Development Software Decisions: NetShow vs RealPublisher

Microsoft's NetShow [Microsoft 1998] was used for the initial development of two of the modules. However, several issues forced us to consider RealPublisher [RealNetworks, 1998] software for development. First, at the time of module development, NetShow had a Macintosh player for browsers, but no plug-in. Terms of the grant included providing software which is compatible on both IBM and Macintosh. RealPublisher provides a plug-in for the Macintosh browsers.

The final version of our CD-ROM product for the NetShow version of the "Searching Library Databases" occupied in excess of 100MB. The RealPublisher version was 17MB. Most, if not all, of the Information Literacy modules will fit on one CD-ROM if development continues with RealPublisher.

NetShow's environment is currently easier to use in terms of the interface. Start and stop times are easily specified within a dialog, as well as the corresponding HTML or image files. The RealPublisher environment currently requires the use of Notepad, where starting and stopping times are manually typed in a specified format. This is error-prone, and needs to be improved.

NetShow v2.0 had several problems when the development was for the Netscape browser. Certain paths had to be encoded as absolute (development for IE browser supports relative paths), and thus, when the module is published to an Internet provider, changes must be made. The beta version of NetShow v3.0 would not play the show correctly, so that the v2.0 player had to be included on the CD-ROM, since product delivery occurred before the final v3.0 was released. RealPublisher's environment did not differentiate between browsers -- the issue of different paths for different browsers didn't exist.

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Libraries, the Internet, and Social Issues

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Abstract

Libraries are a place where a number of societal issues related to the Internet come together. As governments around the world address societal issues relating to the Internet, some of the experiences of the American Library Association can be helpful in developing strategies to take full advantage of this important learning tool. For more about this educational campaign, see the ALA home page - http://www.ala.org.

Introduction

Many societal issues related to the Internet come together and can be addressed at the library. Libraries provide Internet access and often training to the general public, addressing the vital question of equity of access to Internet resources and the need to "re-skill" out-of-school generations. Librarians, in their traditional roles, handle challenges and mediate inter-group conflict, set standards and criteria, and seek out and identify resources that should be available on the Internet.

The American Library Association (ALA) – the voice of America's libraries, and the world's oldest and largest library association – is both using the Internet to provide services to its 57,000 members and beyond and is acting vigorously to protect free and uncontrolled access to information resources, including the Internet. Opportunities are also provided for Association members to enhance skills and maintain competencies in response to changing work practices, rapid development in technology, and expanding needs of library users.

Protecting Access to Internet Resources

ALA was at the forefront of the legal battle in the U.S.A. to protect citizens' First Amendment rights on the Internet. The U.S. Supreme Court ruled the Communications Decency Act unconstitutional. This act had been proposed as a way to keep obscene materials out of the hands of children, but the Court ruled that the act, as passed by the U.S. Congress, abridged the rights of adults to access legally-protected materials or speech on the Internet.

Following this ruling, in July 1997, U.S. President Bill Clinton and Vice President Al Gore convened a small closed meeting with politicians, Internet industry leaders, and educators – including a representative of ALA – to discuss children and the Internet. The ALA representative discussed librarians' critical role in reviewing and recommending web sites, just as they select books and other materials. ALA also noted that while technology is an important tool, education – particularly development of information literacy skills – is still key. A toolkit – "The Librarian's Guide to Cyberspace for Parents and Kids" – was introduced at this meeting.

Librarians as Internet Organizers and Evaluators

Following on the White House meeting, the Internet Online Summit: Focus on Children was held in Washington, D.C. in December 1997. The Summit brought together public interest groups, computer and communications

industry representatives, government leaders, and citizens to address ways to ensure that the Internet experience is safe, educational, and entertaining for children. As one of the summit sponsors, ALA was involved in both planning and implementation.

As part of the concluding panel at the Summit, ALA affirmed the role of libraries as key points of access for children and families who cannot afford computers, as well as ALA's commitment to protecting First Amendment rights. In the library setting, this raises complex issues for librarians seeking to follow legal guidelines regarding access to legally-protected speech as well as laws regarding illegal speech.

ALA's "700 Great Web Sites for Kids and the Adults Who Care About Them" – reviewed and recommended by children's librarians across the country – was presented at the Summit. Over 50,000 web sites were reviewed to select 700. KidsConnect -- a question-and-answer service where children can get online help with their homework – was also highlighted. These and other ALA efforts to educate and support parents and children in using the Internet have been featured on the "Today Show," in *Parade Magazine* and *The Washington Post*, and in other media throughout the U.S.A.

Libraries as Providers of Internet Access and Continuous Learning

Historically, the role of libraries is to bring people together with information – not to block information. ALA believes currently-available filtering tools can be useful in the home, but it does not endorse their use in libraries, because studies have shown that legally-protected and useful material about sexuality, health, and other sensitive subjects may also be blocked by currently-available tools. Libraries are in an extraordinarily difficult position. The courts have established that minors have the same constitutional rights as adults to free speech, except for a class of information identified as "harmful to minors," which is defined at the state, not federal, level.

ALA has focused on educating parents about the issues and how they can work with their children to make good use of this revolutionary learning tool – the Internet. Parents not wanting children to access certain sites must teach kids which sites to avoid – as parents have historically designated safe and unsafe streets or neighborhoods for children.

With less than 20 percent of homes in the U.S.A. connected to the Internet, libraries provide important Internet access for many. ALA is continuing to build its web site into a dynamic Internet collection for children and parents, as well as providing links to libraries around the world that have online children's sites. "Teen Hoopla" – developed by young adult specialists within ALA – was unveiled in January 1998. Librarians provide continuous learning and guidance for adults and children in using the Internet. If the Internet is our vehicle into the next century, librarians are the navigators.

Conclusion

As governments around the world address societal issues relating to the Internet, some of the experiences of the American Library Association can be helpful in developing strategies to take full advantage of this important learning tool. For more about ALA's educational campaign, see the ALA home page – http://www.ala.org

Technology has provided opportunities to expand the global reach and local touch of libraries by providing expanded lifelong learning opportunities for library users and staff. As the Internet grows and becomes more complex, libraries will continue to be key in organizing the resources and educating the public about what is available. Libraries are places where many societal issues related to the Internet come together and can be reasonably debated and addressed by communities. By working together, librarians can ensure the availability and use of this important learning tool.

Developing an Online Help System for a Complex Search Engine

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Abstract. *Culture and Technology* is a CD-based software containing over 15,000 text pages, video clips, and audio tracks. A complex search engine allows users to find appropriate resources in a variety of ways. Targeted documents include information sheets (abstracts of the documents as well as categorization parameters), multi-paged documents, links to related material and several system-level options.

This article discusses strategies used to develop a suite of web pages designed to tutor present and potential users, serve as an online help system, and respond to user needs. The web suite contains over 130 web pages of information and a comprehensive index.

Goals

As the designers of the online help system for *Culture & Technology* we hoped to augment the abbreviated help system contained in the software, and improve on the paper based tutorial supplied as part of the programÕs documentation. We also hoped to provide existing users a comprehensive index of terms and processes associated with the product, and to develop a dynamically growing collection of frequently asked questions (FAQs) which could be used to help refine future versions of the product. Finally, we believed that by illustrating the programÕs features, we could generate additional consumer interest in the product.

Decisions

A tutorial system should be comprehensive yet easy for the user to navigate. We decided that the tutorial should present a realistic, task oriented activity illustrating an actual search using the *Culture & Technology* search interface. After guiding the user through a ÒtypicalÓ search, we would engage in a more free-form exploration of the programÕs features. Since web materials can be designed using a linear or random access format, tutorial design problems centered around whether too many choices interfere with a noviceÕs learning experiences. Specifically, we feel that the successful instructional design of such a tutorial depends on isolating the pitfalls associated with the activity, providing a rich enough context for meaningful exploration, and devising a system sophisticated enough to attend to the user in an ÒintelligentÓ way. We decided to create a presentation which initially offers little choice and gradually evolves to include more links. Further, we ÒchunkedÓ the tutorial into functional pieces and allowed users to randomly access specific parts of the tutorial (the section on printing, for example).

Culture & Technology is a complex program, and that complexity is compounded by the softwareÕs dovetail with the computerÕs operating system. Since our online help system had to address sophisticated processes as well as program features, we decided to use a color-coded convention throughout the system. If an object under discussion is related to a process supported by either the computer or the *Culture & Technology* program, the object appears as bold red print. If the object is an item in a list or a document, its name will be in bold black print. We are currently setting up an informal research study to determine the effectiveness of this strategy. Our instinct is it will take multiple iterations through the material before a user will internalize the color-coding scheme.

Any sophisticated software system contains too many features to discuss effectively in a tutorial format, and *Culture & Technology* is no exception. In addition, users sometimes want straightforward definitions, descriptions, or examples of terms without verbose tutelage. We decided to include a comprehensive index, essentially a linked list, as part of the help system. Further, we decided that there were many cases where the index should provide information distinct from that presented in the tutorial. In other words, although terms in

the index could easily be linked to the tutorial, there were often very good reasons to construct new documents containing alternate explanations. These included simple definitions, meanings of iconic representations (buttons, for example), identification of a levelÕs function (Òshow me what each screen element means or doesÓ), and information not related to the programÕs function. Indexing seems a perfect use of the web, since indexed documents can be linked to each other to provide additional information, and Òsee alsoÓ references.

Marketing

We found the nearly obligatory ÒFrequently Asked QuestionsÓ component of our online help system to be surprisingly useful. In addition to obtaining user requests for features, we are able to disseminate some important information. We offer general information about the programÕs content, which doesnÕt seem to have a place in the index or tutorial. In the software section, we can discuss installation procedures, and offer updates to the search engine software free of charge (our software requires CDs to operate). The access section (Òwhere can I buy the product?Ó) provides a direct link to marketing. Although research shows that selling goods electronically may be 40 to 50% cheaper than by conventional means [Maglitta & Booker, 1994], we feel that it is perhaps more important that marketing efforts link to help systems. A potential buyer may read information about the product and also take a tutorial tour. We feel that this may help overcome the customerÕs anxiety about using a new product. In addition, seeing a comprehensive help-system online may encourage the purchase of the product. According to Bernadette Tracy, president of NetSmart, the internet can Òcan generate virtually pre-sold customers for a variety of products like cars, computers, cruises and financial services. It can provide leads and prospects who are predisposed to buy as a result of their interactive online relationship [Tracy, 1996].Ó Executives seeking web-based solutions for their businesses seem to agree. A survey released by Computer Research Corporation [Meyer, 1998] found that more than 60% of survey respondents confirmed that both their existing and planned web-based business initiatives focus on marketing and sales solutions that promote profitability through expanded sales channel options and strengthened customer relationships. Finally, the online tutorial provides a simple way for sales people to demonstrate the capability of the system in vendor booths or in a customerÕs office.

Future Directions

Based on the information gleaned from working with *Culture & Technology*, we are developing a new online help system for our latest software release *Enhanced Science Helper*. Although we will use a similar approach to the system, including a comprehensive index and tutorial, we intend to incorporate some new features into the help system. We feel strongly that animation can be an effective way to present process information about software functioning. We will offer sample documents, including digital video samples as free downloads. We will offer a demo version of our search engine as a free download. Downloaded software may contain promotional material and/or discount coupons for fully functional versions.

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The development of the Japanese learning system which used PDA (Win. CE)

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It is extremely difficult to learn Kanji Character of Japanese for the learner who learn Japanese as a second language. Because, the Kanji character is complicated compared with the alphabet and there is much number stroke. The Kanji character is the ideogram character of the origin of which is China.

We already have developed the Japanese learning system using personal computer (MAC) and handwriting input system. But, This system was not the one which it is possible to use anywhere for the learner. Therefore, we decided to use the PDA as a platform. That PDA is "CASIOPEIA". It is operated by "Windows CE". And, it is simple in the development of the program and the data maintenance by the personal computer.

In this conference, we will explain the outline of this learning system and demonstrate the performance of this system.

Greek Indexer - A New Web Subject Catalog: Statistics, Comparisons and Study of Net-Surfer Web Preferences

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Abstract: A lot of surveys have covered many aspects of user habits, ranging from age to social status of web users and from political preferences to security issues. However, only little work, based on log file analysis data of a web subject catalog, has been conducted to unveil the most favored kind of resources the users access. The development, maintenance and analysis of web server's log-files enlighten many useful aspects of the way users traverse the web and click through links. Based on access log-file data from three famous subject catalogs, this paper measures and compares the most favorite user subject categories and draws some guidelines on the potential content that creates a successful and highly accessed site.

1. Introduction

The potential of the World Wide Web [Berners 1994] has been widely accepted as the most useful means of transmitting information throughout the world in a platform-independent way. A lot of surveys have covered many aspects of user habits, ranging from age to social status of web users and from political preferences to security issues. However, only little work, based on log-file analysis data [URL 7] of a web subject catalog, has been conducted to unveil the favored kind of resources the users access. Based on access log file data from three subject catalogs (Greek Indexer [URL 4], Starting Point [URL 5] and Yahoo [URL 6]) this paper measures and compares the most favorite user categories and subjects and draws some guidelines for a marketing company, a webmaster or an institution on the content that will create a successful and highly accessed site.

Web demographics can help web site creators to improve the site contents or site appearance and simultaneously reveal common user attitude while traversing whole web document structures [Vassiliadis et al. 1997], [Garofalakis et al. 1997].

A lot of surveys have been produced to investigate a wide range of web demographics. The 6th WWW User survey [URL 2] answers questions on the web and Internet usage, the percentage of male and female users, data privacy, politics, security of transactions and web-mastering. Many media researchers and marketing campaigns are increasingly using the WWW. It is about one-forth less costly to perform direct marketing through the web than through conventional channels [Verity 1994]. Recent research [Hoffman 1996a], [Hoffman 1996b] also suggests the demographics of Internet use are shifting over time, with the result that the Internet appears to be going more "mainstream" in its demographic makeup and that this trend is likely to continue as the Internet moves toward critical mass as a commercial medium. Also, other studies that address the issue of who is on the Internet and what they are doing there can be found at CyberAtlas [URL 3]. Also information about a proposed ubiquitous advertising on the WWW can be found in [Kohda and Endo 1996].

This paper is divided into 2 parts. The first part describes the process of developing and operating the biggest Greek-oriented web subject catalog, named "Greek Indexer", at first. By measuring the total number of accesses on every category of the catalog, the most user favorite themes can be defined by counting the absolute number of accesses to each category. The second part of the paper compares the above results with the ones that come from a similar measurement of two other famous international subject catalogs (Yahoo Inc., and Starting Point Inc.)

The GI's access log files being used in this survey start from December '95 until April '97. Starting Point's logs are from January '97 to March '97. As far as Yahoo is concerned, a three months' "What's New" web pages are considered.

This paper is organized as follows. Section 2.1 addresses the technical issues faced to develop the Greek Indexer on-line service, while section 2.2 describes its operational and maintenance issues. Then,

in section 3, a detailed statistical analysis shows the most favored web-user categories. Section 4.1 shows the most frequently accessed categories from Starting Point's subject catalog. Section 4.2 shows Yahoo's "What's new" service and category specific results are being conducted. Section 5 makes some comparisons between the three subject catalogs, while section 6 concludes on the ways of exploitation of web preferences results, ranging from marketing to multimedia page design.

2. Greek Indexer

"Greek Indexer" (GI) is a Greek-oriented hierarchical web directory that is being used by both Greek users and foreigners who want to locate up-to-date Greek oriented information. GI has been on-line since December 1995 at http://www.gr-indexer.gr/. It currently serves more than 8500 accesses per day from all over the world (measuring unique hostnames). The number of hits, (including html documents, images, sounds), exceeds 1,900,000hits per month and is linked by more than 4,000 web pages. It is updated twice daily and contains an up-to-date image of the web resources existing in the Greek Cyberspace.

2.1 Technical Issues

Each GI's link has the following structure:

- A 2-3 word description of the resource
- A small English Description defining the main purpose of the site
- A small Greek Description defining the main purpose of the site

GI consists of a set of CGI scripts [URL 1] and a lot of dynamic HTML pages. The scripts are written in PERL and C programming language and being deployed to collect, analyze and sort input data. People, who want to have their site or even other's owned web resource listed in GI, should click on the "Add link" button. Then they enter useful data such as a 3-word description of the new web resource, an English and a Greek description of the site and their e-mail address for notification of the date the link is included in GI.

When all the required data are submitted, an error checking routine is automatically run against them. The error checking routine verifies the existence of the user e-mail address, the URL and of valid, no-blank strings for the description of the resource. If the submitted data do not contain errors then a new entry containing the link for the submitted category, is automatically being built as HTML code. This code is being inserted into a temporary file and a final acceptance or rejection is carried out by GI's administrators. Administrators supervise the addition of the new links by checking if the sentences representing description of the new web resource are semantically and syntactically valid for bot Greek and English language. They also check if they contain unacceptable words (i.e. insults). Upon approval, the link becomes part of the Dynamic HTML page that represents the links for a particular category of the catalog. At the same time, two e-mails are being sent. The first one is destined to the administrator of the catalog to inform him about the new addition and enable him to have the maximum possible logging parameters (e.g. IP address, time etc.) and is stored in an SQL Database. The second e-mail is sent to the user who submitted the entry and informs him about the link addition as well as with much other useful information about the GI (e.g. advertisement of new services, new banners etc.).

Server-Side Includes (SSI) was exploited to create Dynamic Pages and banner advertisements. They do not consume too much CPU time and help the webmaster make additions or modifications to the whole setting of the site easily and effectively. The APACHE web server provides many additional capabilities such us advanced debugging, script management and configuration, flexible scripting interface (ISAPI) etc. The further exploitation of those features is currently our concern.

The banner advertisement appearance is defined in GI's configuration file. There are two options. The first option is category-specific advertisements where the banner is appeared only in that particular category. When GI is displaying a category and does not have any category-specific advertisement, a random banner is being picked from the rotating advertisement repository. This pool contains banners images that are meant to be displayed randomly throughout the GI's pages without any category-specific advertisement.

Each user can have more than the default appearance of GI's categories. The user is free to choose from a variety of colors for text and the inclusion of graphics. From user's perspective the configuration is simple by entering the desired values in a simple web form. From server's side the definitions of different user preferences are easily handled using CGI and cookies.

2.2 Operational Issues

Despite explicit note on what kind of data should be inserted to each GI's field, many users tried to insert arbitrary or incorrect data. A lot of users tried to insert all of the description's words in capital letters and others

with symbols like "!", "*" or even ":-)" (smiley) to emphasize the sentences. Some others did not provide their e-mail address for notification if the link is accepted for inclusion or not to the directory.

Many users were sending multiple copies of the same link to the same category, which was a serious matter of concern. Blank additions were not common but existent, despite the fact that in most cases there was no network overload or line drop during the link addition process.

At present, the scripts used in GI can diagnose many kinds of common user mistakes and can handle many problematic situations.

3. Greek Indexer Metrics

The development, maintenance and log file analysis enlightens many useful aspects of the way users traverse the web and click through links. In this paper the GI's access log files being used are from January 1st, 1996 until April 30th, 1997.

The Greek Indexer consists of 37 top-level categories, overlooking its first highly accessed page. At this point we define the following equation:

$$P_i = A_i / A_{total}$$

,where **i** is one of the 37 categories, P_i is the percentage of the accesses the category **i** has against to all the other categories, A_i is the total number of absolute accesses to Greek Indexer's category **i** and A_{total} is the sum of all accesses to all GI' categories. The greater the percentage (P_i), the more favorite for users the category (**i**) is.

[Tab. 1] has been compiled to show the accesses of each category. The 1st column gives the name of the category, the 2nd column shows the percentage of accesses of each category (P_i) out of the total access that this category has currently served and the last column introduces the Anticipated Annual Growth (AAG) of each category. The AAG is calculated as follows: Let **i** is one of the categories. The number of accesses of category **i** (for all categories) in 1996 (A_i) is being calculated. Then the accesses of each category of the first quarter of 1997 (B_i) are being counted, which multiplied by 4 can approximately show the number of accesses in the year 1997 for that particular category. The percentage of the absolute difference from the accesses of year 1996 to 1997 is named as "Anticipated Annual Growth". So the AAG for category **i** (AAG_i) is defined by the following equation:

$$AAG_i = ABS\left((A_i - 4*B_i)/(A_i + 4*B_i)\right)$$

Name of GI's Category	% of Total number of Accesses (P_i)	Anticipated Annual Growth (AAG)
Sex	13.20%	426%
Universities & Institutes	7.90%	284%
Internet & its services	7.31%	240%
Newspapers	6.30%	269%
Entertainment	5.62%	282%
Magazines	5.08%	232%
Business	4.86%	277%
User Home Pages	4.61%	313%
Cities, Islands & Travel	3.96%	237%
Sports	3.74%	346%
Pictures & Photography	3.31%	308%
Radio	2.93%	417%
TV	2.61%	254%
Education	2.23%	468%
Cities	2.04%	297%
Cars	1.94%	320%
Governmental	1.87%	283%
Culture	1.77%	212%
Computers	1.58%	421%
Banks	1.54%	224%
Directories	1.35%	180%
Food	1.30%	232%
Organizations	1.22%	242%
Politics	1.17%	188%
Daily Services	1.09%	151%
Economy	1.05%	333%
Announcements	1.03%	188%

BEST COPY AVAILABLE

Astronomy	0.92%	260%
Insurance	0.89%	161%
Associations	0.87%	268%
Societies	0.73%	216%
Services	0.73%	228%
Religion	0.71%	319%
Health	0.68%	360%
Mathematics	0.67%	246%

Table 1: GI Detailed Category Accesses

Combining the above top-level categories in a wider sense, merging the categories with semantic similarities to create fewer categories of wider meaning, [Tab. 2] is produced. Its 1st column shows the concatenation of top-level categories (whose 1st level categories are contained in each wider one), the 2nd column shows the name of the wide category, the 3rd column shows the number of accesses as a percentage of the total accesses of GI categories and the last column shows the "Anticipated Annual Growth".

4. Other Subject Catalogs

There are a great number of subject catalogs currently on-line. In this paper two of the most favorite ones are used to help us contact our research on web subject catalogs.

For both catalogs we calculate, similarly to the method used for GI, the percentage of the absolute accesses that the category **i** has (P_i).

Name of 1st level categories being merged by semantic similarities	Name of the Wider Category	% of Total Accesses	Anticipated Annual Growth
Entertainment & User Home Pages & Sex	Entertainment	23.28%	363%
Radio & TV & Newspapers & Magazines	News & Media	16.81%	276%
Universities & Institutes & Education	Education	10.07%	317%
Computing & Internet Services	Computers	9.92%	251%
Business & Insurance & Cars	Business	7.64%	271%
Cities, Islands & Travel	Travel	6.57%	250%
Politics & Government & Organizations	Social Services	4.23%	243%
Sports	Recreation	3.72%	346%
Pictures & Photography	Pictures	3.29%	193%
Announcements & Directories & Services	Announcements	3.09%	308%
Economy & Banks	Economy	2.58%	264%
Culture & Religion	Culture	2.47%	239%
Food & Health	Health & Fitness	1.97%	271%
Societies & Associations	Societies	1.60%	243%
Mathematics & Astronomy	Sciences	1.58%	254%

Table 2: Wide GI's categories

4.1 Starting Point Inc.

Starting Point Inc., located in US, is one of the most frequently accessed sites providing information to numerous users every day. Starting Point offers an extensive web directory with carefully selected links. The top-level categories include links for **Entertainment, Magazines, Business, Weather, Travel, Computing, Sports, News, Education, Shopping, Investing, and Reference.**

Full server logs (from January 1st, 1997 to March 30rd, 1997) were on our disposal to measure various parameters and construct [Fig. 2]. It shows the most frequently accessed categories at Starting Point's web site. The percentage of a category is calculated by dividing all of user accesses to that particular category by the total number of accesses to all categories.

4.2 Yahoo

Yahoo is a semi-automatically constructed and hierarchically organized web directory whose links come from user submissions only. We used Yahoo's "What's New" section to reveal the trends on the increase of new sites included to it. For statistically correct results, three-month new additions were examined and the results are being presented in [Fig. 3].

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All of the new additions are categorized under one of the following main categories: **Business & Economy**, **Entertainment**, **News & Media**, **Society & Culture**, **Arts**, **Computers & Internet**, **Science**, **Health**, **Government**, **Social Science**, **Education**, **Reference**.

Despite the fact that Business & Economy category has much more percentage than the others , this is due to the way Yahoo categorizes its links. The percentage is virtually shared among entertainment, recreation and media. In Yahoo, there is an implicit emphasis in the categorization of links in specific business oriented parts and less to top-level generic categories. For example, most of Yahoo's links are being categorized under Regional/Countries due to the fact the Yahoo wants to have its links country specific sorted, which is a vital and highly acceptable criterion.

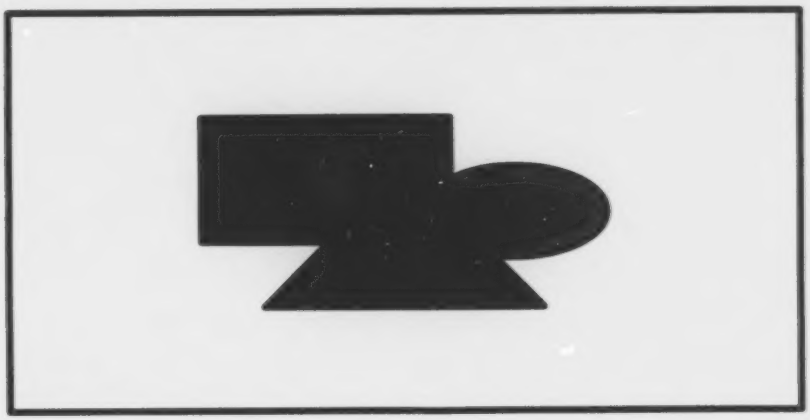

Figure 2: Starting Point's Categories Distribution

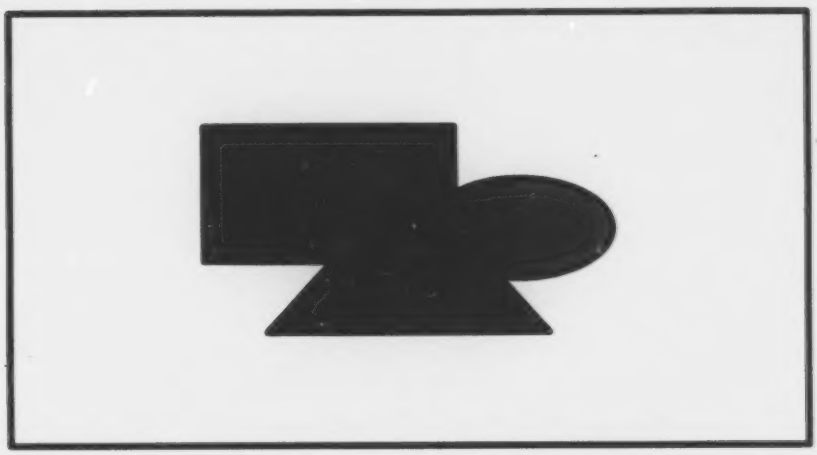

Figure 3: Yahoo's "What's New" Categories Distribution

5. Comparisons

The above data reveal which are the subjects that web users more frequently access. [Tab. 1] shows the GI's categories that are mostly accessed. [Fig. 1] and [Fig. 2] shows the most interesting links to the users based on data coming from Starting Point Inc. and Yahoo.

Comparing the above, a lot of common similarities can be extracted. People mostly like to visit Entertaining material (e.g. Fun, Music, leisure time etc.). News & Media follow (e.g. TV, Magazines, Newspapers etc.). Educational issues are at the third place (e.g. Universities, Institutes etc.). At the fourth place Sports, Travel and Recreation, while the fifth position is populated with Cities and geographical information and Economy.

The three catalogs have many differences on the number of registered links, the number of visits per day, the country that they operate on and the audience they would like to attract. Greek Indexer is oriented to Greek resources and accepts links with Greek content. Most of its users are Greek people or people who would like to visit Greece. Starting Point and Yahoo are more general catalogs and have registered sites from all over the world.

Despite the fact that all three catalogs can not be classified in a common place, this paper reveals that there are many similarities between the type of information web users access, regardless the country they come from or the type of Internet connection.

6. Conclusions

Commenting on the results of the previous sections, conclusions on many aspects of the process of web site and web content development can be made. The most common of them is the type of the information provided by a particular web site. A web user clicks on a site and browses its pages only if this material is of interest to him. The statistical analysis of this study have shown that only if the site belongs to at least one wide subject category do the user visit the site frequently. If the user likes to access such a category, then it is more likely to choose one of the top ranked sites mentioned in [Tab. 2]. Web users most favor sites with entertaining subject such as music, humor, movies, home pages etc. Sites with informational material such as broadcasting channels, TV, Radio and Newspapers as their second concern. Educational material is in the middle of their preference. Business and Economy comes next.

Bearing in mind that searching using a robot produces indiscriminate quantity of potential data, subject directories are the means of producing a list of quality information resources that quickly guide the user to the desired subject area. Handling the expiration of the catalog's links is a great concert and must be handled in an efficient and user transparent way.

The provision of user customizable information should be considered when building a subject catalog. The next generation subject catalogs might provide such option to the average user. The first step to that direction is the provision of country specific options in web subject catalogs.

Our research team is currently involved in the improvement of the link classification, expiration and re-organization. In addition, research on building sophisticated analytical and statistical results from web server log files is also in progress. The successful definition of user sessions and a link re-organization procedure for the contents of a web site is under beta testing [URL 8].

Acknowledgments

All of the above work wouldn't be feasible without the help of HIWAY Network and Starting Point Inc. We would like to thank HIWAY Network for their generosity to give us the log files of the Greek Indexer as well as Mr. Frank Addante for the provision of the 3-month log files of Starting Point to be used in this survey.

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How to Use HTML Page Popularity to Improve a Web Site's Structure

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Abstract: The structure of a World Wide Web Site (i.e. how its HTML pages are linked together) is a serious concern to all web administrators. Nevertheless, an inapt page arrangement can discourage a potential Internet user as it fails to present properly the site's contents. In this paper, it is discussed how a link-editing algorithm, based on Relative Page Popularity (RPP), can be used to automatically revise the initial page structure and build a new one, that exhibits a significantly higher number of accesses. It is also examined how one can define the notion of popularity among HTML pages, and how the re-arrangement of a Web site, based exclusively on page popularity, can lead to a substantially more effective scheme.

1. Introduction

The notion of a log file is to record every request that a server accepts accompanied by some extra information such as date/time of the request, the client who submitted the request, which file was requested etc [URL 2] , [Vasiliadis 1997]. Based on this neat source of information we can make many significant observations that can contribute to a higher overall performance of a given WWW [Berners et al. 1994] site. One of them, called page popularity henceforward, is the subject of this paper. It is examined how one can define the notion of popularity among HTML pages, and how the re-arrangement of a Web site, based exclusively on page popularity can lead to a substantially more effective scheme. An author-oriented link management system can be found in [Creech 1996].

This paper is organized as follows: Section 2.1 and 2.2 define the basic knowledge behind Page Popularity; section 2.3 contains a case study of link re-arrangement and a is fruitful of information of the proposed algorithm. Section 3 shows the commercial use that bring out of this paper, while section 4 and 5 conclude and define our future work, respectively.

2. Defining Page Popularity

One easy but rather unjust way to estimate which page is the most popular, is to calculate the accesses to this page based exclusively on a given Log File [URL 1]. Indisputably, this approach has many weak points. The so-called **absolute accesses** might mislead the evaluator since the closer the page is to the home page (the initial page of the server) the more accesses it will probably have, as it stands on the path(s) from the home page to a target page located deeper in the HTML tree[1]. As a child-page might have links towards one of its ancestors, the term "tree" is not absolutely felicitous. Nevertheless, the factors that must also be taken into consideration when popularity is examined are:

- the depth of the page (how far it is from the home page)
- how many pages are at the same depth as the page that is being examined
- how many references (hyperlinks) this particular page has from other pages of the server

Let's assume that there is a factor ***a*** that embraces all the above parameters. Then, we can coin a new term called **relative accesses,** which is derived from the following equation:

$$relative\ accesses = a * (absolute\ accesses) \qquad (1)$$

[1] HTML tree: Home page is the root of this tree, and every hyperlink to another page constitutes a parent-child relationship.

2.1 Defining the coefficient *a*

As the depth of the page ***d*** can detract from the popularity of the page, it is reasonable to assume that coefficient ***a*** must be proportional to ***d***. Likewise, the number of pages at the same depth ***n*** should be proportional to ***a*** since the number of different choices is bigger and the selection of a specific page carries more weight. Of course, we must take into account the number of references ***r*** from other pages, as they generally bolster up page popularity, and so r must be in inverse proportion to coefficient ***a***. Since we usually don't track down the references to our pages from all around the world, ***r*** normally is an estimation based on the references of our own pages.

Putting them all together, the relation between ***a***, ***d***, ***n*** and ***r*** should have the following form:

$$a = F(d, n, 1/r) \qquad (2)$$

In the subsequent paragraphs it is presented how the selection of a specific formula can affect *user's profile*[2], as this is recorded in the Log File.

2.2 Link Editing

We have developed a pilot software (SOALA v2.0) [URL 3] that has the ability to reorganize the links between pages based on some criteria that were previously set by the Web Server's Administrator. In the following measurements, if the relative popularity of a given page exceeds the popularity of at least one page with shorter distance from the home page, then a link re-arrangement occurs. The calculation of RPP (Relative Page Popularity) can be done periodically (e.g. every week) and the metrics, which are usually calculated, as the most instructive, are:

- **PT**: the mean page time (i.e. how much time a user spends on a specific page)
- **UT**: Mean elapsed time (i.e. how much time a user spends on the server every session[3])
- **NA**: number of absolute access per page
- **RA**: number of relative accesses per page
- **NP**: mean number of pages (i.e. how many different pages a user visits every session)

A simple version of the link-editing algorithm has as follows: "***If any page has RA higher than its parent, then interchange it with its parent page. Repeat the previous step until every page has ancestors with higher RAs***".

In the following paragraph the above algorithm is applied for a specific definition of factor **a**. It is really instructive to observe how an awkward organization of a WWW Server can discourage Internet users and how link editing (based on relative accesses) can be used as a first-class remedy.

2.3 Case Study

It is important to mention that in order to have results as accurate and untainted as possible, only authorized permission was permitted. Therefore, the authorization field of the Log File is not empty "-". Furthermore, there were no references to our site (outside our Server) so that the value of parameter ***r*** will be accurate. The group of users, as well as the pages, was selected carefully to facilitate the interpretation of the results.

According to the above discussion one possible way of specifying the coefficient ***a*** can be the following equation:

$$a = d + n/r \qquad (3)$$

Any abnormal value for time variables (too small or too long) was discarded. The site comprised 32 pages (namely Page1, Page2, ..., Page31) organized into the binary tree structure depicted in figure 1. Page1 is the initial home page having two children (Page1, Page2). For every n=1 to 15, Page(n) has two children: Page(2n) and Page(2n+1). There is only one reference to each page (one from its parent,

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[2] User's profile: User's behavior towards a Web Site (i.e. what pages he visits, in what order, for how long etc.)

[3] Session: each time a user accesses the WWW Site, a new session is initiated. All the successive accesses belong to the same session provided that the interval between them does not exceed a given time-threshold.

with the exception of home page) and therefore parameter r has a value equal to 1 in any case. It is important to underline that the binary structure remains until the end. What changes is the position of the pages in this structure. For instance, at the end of link-editings Page3 occupies a position in a deeper level (in the HTML tree) than the initial one.

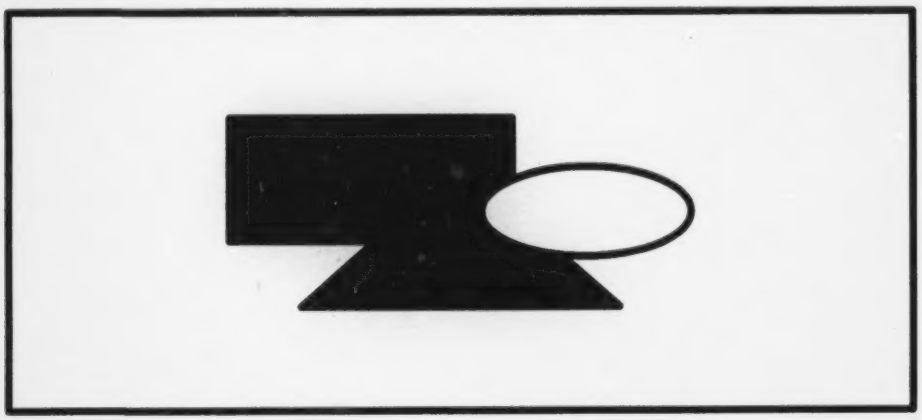

Figure 1: Initial Binary Tree Structure

[Tab. 1] summarizes the accesses to our system prior to any link editing. For example Page2 has 181 mean page time, 340 absolute accesses and 1020 relative accesses (RA=a*NA, where a=d+n/r=1+2/1=3)

PAGE	PT (in sec)	NA	RA
Page1	32	571	571
Page2	181	340	1020
Page3	42	224	672
Page4	12	105	630
Page5	55	175	1050
Page6	11	93	558
Page7	112	120	720
Page8	39	69	759
Page9	41	34	374
Page10	36	40	440
Page11	198	122	1342
Page12	47	31	341
Page13	37	60	660
Page14	41	60	660
Page15	44	27	297
Page16	14	3	60
Page17	154	56	1120
Page18	50	16	320
Page19	33	11	220
Page20	42	14	280
Page21	47	17	340
Page22	201	51	1020
Page23	49	13	260
Page24	53	13	260
Page25	31	7	140

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	188	48	960
	22	4	80
	29	9	180
	176	39	780
	12	2	40
	47	12	240

Table 1: Measurement of accesses prior to link editing

As it can be inferred from [Tab. 1] the initial arrangement of HTML tree was rather inapt. Pages such as Page22 were undervalued as they exhibit significantly higher RA than other pages located closer to home page. Applying our link-editing algorithm to [Tab. 1] results in a new binary tree that is depicted in [Fig. 2].

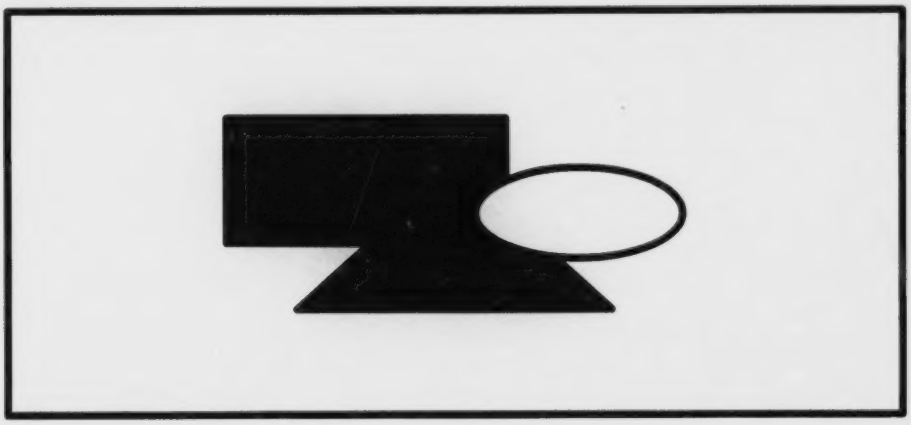

Figure 2: The Revised Binary Tree

[Tab. 2] summarizes the new measurements based on the revised binary tree.

	44	12	240
	183	160	960
	67	98	588
	27	4	80
	56	196	1176
	23	5	100
	119	89	979
	37	25	275
	42	64	704
	36	75	825
	145	837	837
	46	46	506
	39	26	286
	47	17	340
	46	40	440
	15	5	100
	131	429	1287
	53	21	420
	35	17	340

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[illegible]	40	22	440
[illegible]	48	25	500
[illegible]	179	80	880
[illegible]	51	9	180
[illegible]	32	15	300
[illegible]	192	12	240
[illegible]	172	334	1002
[illegible]	22	8	160
[illegible]	33	25	500
[illegible]	169	182	1092
[illegible]	16	3	60
[illegible]	48	15	300

Table 2: Measurement of accesses after link editing according to the revised binary tree

As it can be easily derived from [Tab. 2], as a result of the new tree-organization, there are pages with a substantially different NA, while the new sum of NAs

$$SUM(NA) = NApage1 + NApage2 + \ldots + NApage31 \qquad (4)$$

exhibits a significant increase ($SUM(NA)_{new}$= 2896, $SUM(NA)_{old}$=2386). UT has been increased too (UT_{new}=352 sec, UT_{old}=259 sec), whereas PT fluctuates. Furthermore, the new page arrangement boosts NP with an increase similar to UT (NP_{new}=5.36, NP_{old}= 3.92).

Even though the statistical nature of the above measurements cannot be neglected, there are significant inferences that can be drawn. First of all, even a neat approach to link editing, based on page relevant accesses, can have a significant impact on user's behavior towards a particular Web Site. Comparing [Tab. 1] to [Tab. 2], it can be inferred that there was a 21% increase in the number of accesses to our site without changing the content of the pages, while the 36% higher NP and UT indicates that the new organization seems to be more convenient and more attractive for a potential user. Another important aspect is that the reorganization can be done automatically: using a simple link-editing algorithm, the system ends up in a more balanced state (from a relative-access point of view).

3. Commercial aspects

The preceding paragraphs substantiate the fact that the organization of a WEB Server can have a sizeable impact. Up to now, it has been implied that the easier a user can find the requested data the better the organization of the WWW Server is. But what happens if a WWW Site contains commercial material (advertisements, etc.)? In this case, the objective is different: probably the best organization is the one that achieves the highest NA to all those pages with a commercial interest. Therefore, a weight factor **w** should be associated with each page and the link-editing algorithm should be modified correspondingly so that the pages with a higher **w** will be promoted more vigorously. The modified version of our link-editing algorithm is beyond the scope of this paper (A beta version is under evaluation with encouraging results).

4. Conclusions

As it was elucidated in the preceding paragraphs, an inapt arrangement of the HTML tree can discourage a potential Internet user. A link-editing algorithm can automatically fix this organization by calculating each page's relative popularity. Even a simple approach to RPP (the combination or relations (1) and (2)) led to a substantially enhanced scheme. After the link editing, we found out that our site had much more accesses than before. Furthermore, users tended to stay longer and visit more pages, showing that the Site was made more attractive even though the content of each page remained the same. Finally, the idea to associate a weight factor with each page was briefly mentioned, so that the

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administrator can single out HTML pages with a particular interest and enable the link-editing algorithm to promote them more vigorously.

5. Future Work

Surely, there is a large number of different approaches of how one can re-arrange the links between pages as well as how to perceive the notion of popularity. For example, one can give coefficient a a more complicated definition than the one given in equation (2), or re-arrange the initial page structure using a more sophisticated method than our link-editing algorithm. Nevertheless, the simple approach that was followed in this paper should not be underrated as, apart from being easily analyzed, it has also been proved to be adequate in most cases.

Probably a link-editing algorithm with the capability of adding new links and discarding others (apart from interchanging pages) would demonstrate a better enhancement.

Our team is still in the process of identifying several new variables that affect the HTML Page Popularity and the new results will be available as soon as they will be extracted.

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An Example of Project Based Learning in a Distance Environment: Financial Statement Analysis Case

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Abstract: Florida Gulf Coast University has a mission of delivering distance courses to 25% of its enrolled students. In finance, the challenge is how to deliver effective learning a distance environment. One method that has been employed is project-based learning.

Florida Gulf Coast University, the tenth university in the State University System of Florida, taught its first courses starting in August 1997. The University was mandated by the state Legislature to have a heavy emphasis on technology, partly to conserve costs of delivering instruction. Part of the mission of the university was to deliver a significant portion of courses via some distance learning modality. Some of the methods being employed are Web-based courses, interactive compressed video courses, videotaped courses, and classes at distance sites.

The College of Business at FGCU embraced this mission and predicted that within a short period of time it would deliver 25% of courses using some distance learning modality. This was in response to not only the mission of the university, but also to student needs and requests. For some classes, the design of distance delivery can be particularly challenging. For instance, in finance and accounting classes the challenges of teaching courses which rely heavily on techniques, but also on conceptual learning, sometimes create difficulty in maintaining the proper balances in courses. One class which faced these challenges is Financial Statement Analysis.

Financial Statement Analysis

Financial Statement Analysis is a junior-level course in the College of Business. Most of the enrollees are either finance or accounting majors. To enroll in the course, students must have completed two semesters of basic accounting and also an introductory finance course. The objectives of the course are to:

- Learn the basics of financial reporting
- Become familiar with basic financial statements
- Learn how to perform a ratio analysis
- Learn how to forecast financial statements
- Learn the role of financial statement forecasting in business planning
- Understand the implications of debt on the firm's financial statements
- Understand growth and how it is reflected in financial statements
- Understand the uses of financial statements in special cases
- Understand how financial statements and special categories of issuers
- Understand the uses of financial statements and "getting behind the numbers"

The course then is one where students learn and refine techniques, but they also work toward a conceptual understanding of various finance and accounting topics. It is a daunting challenge in any environment, but in a distance environment it is even more of a challenge to effectively teach such a course.

One way to make the course more effective has been to base the learning on a semester project. In other words, students learn financial statement analysis by actually analyzing financial statements.

Project Based Learning

In the past, the efficacy of project based learning has been examined in some detail. [1991, Hunt], [1989, Muller], [1996, Verderber, and Serey]. Some authors find that project based learning helps students to "engage actively in self-exploration, self-discovery and self-evaluation." Other authors find that project based learning can be quite successful, but require that faculty must assume extensive additional responsibilities for effective student learning to occur. Among the activities that contribute to the success of project based learning are:

- Effective Goal Setting
- Teaching Student Project Management Skills
- Effective Project Consultation and Monitoring
- Effective Feedback

Financial Statement Analysis Course at FGCU

Keeping in mind these suggestions, the financial statement analysis course for the College of Business at Florida Gulf Coast University was designed. The Web page for the FGCU Financial Statement Analysis course may be viewed at http://www.tmag.com/sgarrison

The Financial Statement Analysis Course is FIN 3461. While walking through the page, it is evident that the project is an important component of the total course. The instructions are shown at http://www.tmag.com/sgarrison/courses/fin3461/assign.html

The project is an in-depth financial statement analysis of a company of the student's choice. The course includes an 8-hour "boot camp" before students enter the Web-based portion of the course. During this portion of the course, students are given detailed instructions on how to prepare the paper. They are also shown samples of previous papers from students who have given permission for other students to use their papers. Students are also given an in-depth session the use of library and electronic resources in preparation of their semester projects.

The paper is turned in by sections, so that if students are "on the wrong track" they have time to correct their work before the final grade is received. Work is carefully monitored and quick feedback is provided students. They are also encouraged to meet in small groups and share their insights.

Conclusions

The course has been quite well received by students. They feel that the project compliments the material they study for the course. By having a practical application of the knowledge base for the course, they report that they retain the principles they learn in the course. A few students have also reported that they have used the projects as a sort of "portfolio" to show prospective employers the kind of work that they have performed in their coursework. All in all, the project-model for distance learning is an experiment that appears to have worked. The instructors will attempt to use such a model in building other distance learning courses.

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Responding to Stakeholders: An Example of Distance Learning Modality in Teaching Finance Skills

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Abstract: Florida Gulf Coast University, the newest in the state university system, opened its doors in August, 1997. As part of the university's mission, departments were mandated to deliver distance courses to 25% of enrolled students. The challenges to the finance department were great, so faculty decided to seek input from stakeholders.

Review of the Literature

Stakeholder analysis focuses on defining quality for education. [Fenwick, 1992] This entails forging a consensus between stakeholders such as learners, faculty, industry, and the community, [Fenwick, 1992], [Kinyanjui and Morton, 1992], [Bruce, 1992], [Maki and Nightingale, 1992]. By including such stakeholders in defining quality, more useful benchmarks may be created. These benchmarks may include dropout rates, assignment response rates, student evaluations, the teaching package, the degree of freedom in pace and content, and the level of independence of students. [Nunan, 1992]. Other inputs may impact on the quality of course offerings [Fenwick, 1992], [Schuler, 1993].

Finance Department Course Design

Keeping these notions in mind, the finance department paid particular attention to building a curriculum by consensus. The department talked to over 80 community business people on what type of graduate they would like to see. In addition, student focus groups to help design the curriculum and courses. The finance faculty also had as a primary goal to build a sense of identity among finance majors. Some of the facts we learned were:

- Businesses wanted to hire students with good communications skills.
- Businesses wanted graduates to have "hands-on" financial skills.
- Students wanted classes at convenient schedules and were quite interested in distance learning modalities.
- Students wanted comprehensive courses, yet carefully designed to optimize their time.

Distance Learning Courses

One example of a distance learning course designed in response to these findings is FIN 3240, the introductory finance course. The Web page for a sample course is located at http://www.tmag.com/sgarrison

FIN 3240 is taught in-class and at a distance. This distance class has been taught three times to good reviews from the students who completed the course. The attrition rate is high in the course (27%), but this compares favorably to the attrition for distance courses at the university (32%) and to comparisons at other institutions.

While "walking through" the page there are a number of items to note. First of all, there are a number of "topic overviews" which give a thumbnail overview of the topic at hand. These are designed to explain some of the theoretical concepts in simpler terms, and to lend the practical bent to Finance learning that employers said they wanted.

There are also a number of tutorials to give students "hands-on" financial training. Some of the tutorials cover the basics of using financial spreadsheets, the basics of working with time value of money, and how to use spreadsheets in valuing corporate securities.

The course page contains the syllabus for the course, as well as some general materials that we developed such as sample exams and various tutorials. We also have a page devoted to each chapter in the course textbook.

The materials that we have for each chapter are objective-driven. We have learning objectives listed for each chapter and all the following materials derive from those objectives. We also include a chapter outline, solved problems and a Web site of the day. In addition we allow students to review the PowerPoint slides that we use in our classes. These are viewed using a PowerPoint animation player. We purposely do not put the actual PowerPoint slides on the page to minimize download time. Also, we have observed students in university classes printing out PowerPoint slides in the lab. We thought that this was not a good use of university resources, particularly when in our class we have the chapter outlines available for student note-taking.

Perhaps the most important feature of the page is the Feedback Form. We decided that in a TQM environment we could not wait until the end of the semester to make course improvements. Rather our goal was to make continuous improvement. To that end, we give students the opportunity to provide us with feedback every lesson. Most of the time, the comments have been fairly gratifying. Occasionally, we get a good suggestion which we can use to immediately improve the course. By responding to suggestions quickly, we feel that we are treating students as stakeholders in the course. We frequently peruse other courses in Finance. Few distance courses are currently being offered., but we try to remain in contact with other Finance professors who work in a distance environment to keep abreast of new developments. (See http://www.cob.ohio-state.edu/~fin/resources_education/edcourse.htm.}

Conclusion

Teaching Finance in a distance environment is a challenging process, but input from stakeholders in the process optimized efforts. The class that developed has been running smoothly and we continually seek to improve it.

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A Design for Delivering Filtered Web Views

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Abstract: The widespread and rapid growth of the World Wide Web is a clear indicator of its success as an instrument for information delivery. At the same time, significant limitations in many current Web-based applications demonstrate the need for new research. This paper describes a design in which the limitation of static, overloaded and "one size fits all" Web sites is addressed through customized Web views. The application domain is a Web-accessible reference guide for the Mississippi Center for Supercomputing Research (MCSR) user community referred to as "SmartGuide." The design makes use of object-oriented methods, full text analysis tools, and user modeling.

Reaching a Diverse User Base

This design presented here and the SmartGuide reference guide grew from a specific need. Mississippi Center for Supercomputing Research (MCSR) consultants faced the challenge of providing technical support to an expanding and increasingly diverse user base. Originally, the MCSR user base consisted mostly of scientific and engineering researchers who had technical backgrounds, and the services offered by MCSR were limited to one or two high performance computing systems. In this environment, MCSR consultants developed and distributed paper-based reference guides that explained how to use the available systems. As time went by, MCSR consultants took on more and more general academic computing support with little change in staffing. MCSR consultants now provide support to statewide users on high performance computing, UNIX and Internet/World Wide Web (WWW) applications.

This shift has increased the user base from several hundred to over ten thousand faculty, staff and students; moreover, the user base now consists of people with widely varying information needs. For example, UM students need to know things like how to get an account, where labs are located, how to use e-mail and how to register for classes through the Web. Instructors need to know things like how to set up a course Web page or mailing list. Researchers need to know about the available computing platforms, software applications, and how to compile a program and run a job on the MCSR computers. As the role of the MCSR expanded, the WWW emerged, offering almost universal accessibility and platform independence with easy-to-use client interfaces. As a result, MCSR consultants began moving from paper-based to Web-based reference materials and now rely almost solely on the WWW for reaching users.

The Challenges

While the WWW offers advantages in distributing information, it also entails new challenges. Keeping MCSR Web pages up-to-date as machines are installed and de-installed, as applications are added and as procedures change is a tedious and error-prone process. With the MCSR, reference material is spread across heterogeneous sources, including

databases, text files and HTTP documents. Separating content from presentation is a good design approach, but integrating the content into a single, unified interface can be a major undertaking. Another challenge is finding a way to organize and present the reference material so that users can easily get to the information they need. This may require some level of information hiding so that users are not bombarded with information that they will never use.

WWW developers most commonly present information to users by manually creating and arranging hyperlinks and storing these with document content in static Hypertext Markup Language (HTML) files. When the user selects the marked text or object, she is taken to the destination document identified by a hyperlink. A domain expert studies the items in a collection to determine where hyperlinks should be placed and how they should be connected to other documents. While the developer may arrange information so that items of interest to a particular type of user are grouped together, there is no real customization. Furthermore, the ongoing maintenance of the Web site, updating document content that is embedded with formatting specifications and validating the links between documents requires significant effort on the part of the developer.

Hypermedia and Adaptive Hypermedia Systems

Over a decade of research on hypermedia offers promising possibilities for enhancing the WWW, the most well known hypermedia system to date. While conventional print technology is rigid in the way that information is presented, hypermedia methods can potentially provide a more flexible way of organizing and presenting information. Ideally, a hypermedia application is structured to avoid information overload; the characteristics, motivations, and needs of different individuals can be taken into account. Bieber and Vitali [Bieber & Vitali 97] offer the following advice: "Web Environments should not overwhelm users by providing too many options. Web environments should include filtering mechanisms to present only the most relevant links, based on the users current goals."

Eklund and Zeiliger [Eklund & Zeiliger 97] note the history of hypermedia usability research predating the WWW and suggest that the next logical step is to apply these research findings to the WWW. They describe the relatively new area of research in Adaptive Hypermedia Systems (AHS), where AHS are defined as "externally structured systems which are explicitly based on hypertext (or hypermedia), and use a model of the users knowledge or goals to modify link or content to present individualised instruction or guidance." According to Brusilovsky [Brusilovsky 96], adaptive hypermedia systems are useful in domains where the system will be used by people with different goals and knowledge and where the hyperspace is reasonably large.

The Problem

The resulting problem is to design an adaptive hypermedia system which (1) allows one to integrate information from heterogeneous sources into a unified interface, (2) provides a filtering mechanism so that users see and interact with a view that is customized to their needs, (3) delivers this information through a Web interface, and (4) supports the automatic creation and validation of links between related items to help with ongoing maintenance of the application.

The Design

We address this problem with a design that makes use of object-oriented methods, full text analysis tools, and user modeling. The major system components are the object server, the Web server, the index server, and the user server. The user, index, and object servers are implemented using the Inter-Language Unification (ILU) system [Janssen & Spreitzer 97] from Xerox Parc. ILU is a software tool for building multiple program modules which are interconnected through language-neutral, object-oriented interfaces. The Web interface is implemented with an Apache HTTP server and Java servlets. ILU clients are built into the Java servlets to support interactions with the other servers.

The Object Server

An object model is needed in this application for several reasons. The data that makes up the reference guide comes from different sources and machines. Requiring a special interface for each data type is clumsy and inefficient. A better

approach is to define a universal and consistent interface for operating on all data types. That is, regardless of how the data is formatted and stored, certain operations, operations which can be expressed concisely and elegantly, are guaranteed to be supported. Also, the application must be designed to easily incorporate new kinds of reference guide content such as audio files or bibliographic references. An object model facilitates the inclusion of new data types into the application.

The function of the object server is to interface with the reference guide content. The reference guide content is modeled as information objects in this case, tasks, examples, knowledge base items, URLs, consultants and terms. The object server sits between the data stores and client modules and responds to client requests. Methods such a GetObject() and ShowHTML() allow clients to interact with the reference guide objects. The object server consults object meta-data to find out how to display objects in a given class. The details of how data types are formatted and stored are embedded in the object server and, as a result, are hidden from other modules in the application. Interaction with the data stores resides in the object server, thereby freeing the client modules from knowing the details of how information is stored and accessed.

The Index Server

In this design, the index server and the user server (described next) provide the filtering capability. The index server responds to a client request by constructing an appropriate query, comparing this query to a set of object surrogates, and returning a ranked list of object ids. Prior to the reference guide coming on-line, a software robot performs a full text analysis of all reference guide objects and generates object surrogates which represent the actual objects. Object meta-data dictates how heavily to weight the various attributes making up the object. The robot first interacts with the object server to get the universe of objects in each class and then to get each object one-by-one. The index server uses the object surrogates that were generated by the indexing robot to decide which objects best satisfy a particular request.

The indexing robot is implemented using Salton's "blueprint for automatic indexing" [Salton 89]. The Vector Space Model [Salton & McGill 83] is chosen as the full text analysis tool for this design because (1) previous studies have shown that retrieval results based on this method are very good, especially when documents are relatively short, (2) the implementation of the algorithm is straightforward, and (3) the similarity function between a query and items in the document set can be computed with a reasonable amount of system resources (CPU, memory, and disk). The limitations of this approach are (1) terms are not always orthogonal, (2) the same term may have different meanings in different contexts, and (3) the algorithm does not take into account the subjective quality of the documents. Also, the fact that two documents, or in this case information objects, share certain terms may not necessarily mean that they cover related concepts.

The User Server

Stated simply, the user server handles user information. For example, the user server keeps track of who is logged in and adds/updates user profile information. A central component of any adaptive hypermedia system is its user model. The user server facilitates the construction of user models by collecting user profiles and then generating stereotypes based on these profiles. Before using the reference guide, the user must first answer a short set of questions related to her background, affiliations, and computer usage. The user server stores the profile information for future visits.

The notion of using stereotypes as a means for modeling users was first introduced by Rich [Rich 79] two decades ago. In order to use stereotypes, the system must have two kinds of information. First, the system must know about the stereotypes themselves for example, what characteristics are associated with a particular stereotype. Second, the system must know what events "trigger" the various stereotypes. The triggers can be one or more user attribute values that imply a particular stereotype. For example, in this setting, the stereotype "UM Student" is assumed if the user indicates that one of her primary roles is the student role and that the institution with which she is associated is UM. It is automatically inferred that people in the "UM Student" stereotype will want to know things like how to register for classes through the Web, how to set up a student organization Web page, what labs are available and so on. Similarly, the stereotype "Supercomputer User" is assumed if the user indicates that one of her roles is the researcher role, that she compiles and runs programs, and that she optimizes resource-intensive programs. In this case, it is inferred that she will want to know things like how to submit a job to a queuing system such as NQS, how to get a research account, and how to evaluate a program performance.

Some user models incorporate stereotype hierarchies where one stereotype forms a subset of another stereotype. In the hotel application, HAM-ANS [Morik 89], facts about the user imply different, independent stereotypes, and a single user can belong to several stereotypes. These stereotypes are mixed together to form a user profile. This design does not use hierarchical stereotypes; instead, it uses multiple, independent stereotypes to describe users as with HAM-ANS. This way, many facets of an individual can be represented, resulting in a rich and expressive user profile. For example, an individual might play the role of both teacher and researcher and would thereby be assigned both stereotypes. A danger with this approach is that an individual may assigned too many stereotypes and, as a result, see widely varying topics listed together in the application.

Rich [Rich 79] identifies three dimensions along which user models can be classified: (1) who is being modeled a canonical user or an individual user, (2) how is the model constructed by the user directly or by the system based on the user's behavior, and (3) what type of information is contained in the model short-term, highly specific information or longer-term, more general information. This user model can be classified according to Rich's dimensions as follows. It uses individualized models for each user. It creates each user model explicitly rather than implicitly by asking the user to respond to a brief set of questions about his or her background and typical use of computers. Finally, this user model keeps both long-term and short-term information about each user.

A collaborative model in which the user is involved in the creation of the model may be the best choice for adaptive hypermedia systems [Brusilovsky 96]. This design uses a collaborative model; specifically, users directly provide information about themselves and, if they choose, can indicate the tasks that best fit their needs through the use of relevance feedback. When the user connects to the *Contents* page, she can indicate the tasks that best match her current needs, and her responses are then used to create a new *Contents* page.

The Web Server

The Web server evaluates user requests and interacts with the other servers in order to respond to those requests. Each user request for a reference guide Web page includes a template name. The template name corresponds to an enhanced HTML file that contains object placeholders along with information on how to match and display (e.g., as references or in full) objects. The Web server consults the index server to determine which objects to include and then interacts with the object server retrieve and display those objects.

Interactions between System Components

Figure 1 shows the system components and how they interact with one another. Listed next are a few examples showing how the various components interact in response to different user requests.

Registering

When the user connects for the first time, she registers by choosing a user name and password. Upon receiving a register request, the Web server gets and validates the request parameters that were provided by the user. The Web server polls the user server if this user name is taken. If the name is free, then the Web server asks the user server to create a new user with this user name. The Web server responds to the user by taking her to the update profile page.

Stating Current Goals

At the start of each session, the user states her current goal and connects to the reference guide. The Web server interacts with the user server to find out if this user is logged in and whether this user has a profile. The Web server requests the index server to initialize this user's session information. The index server gets the stereotypes for this user from user server and updates the session information. If the user has entered her current goals, then the Web server requests the index server to set the goals for this session. The index server evaluates the goals statement and updates the session information for this user. If these actions are successful, then the Web server responds to the user with a *Contents* page.

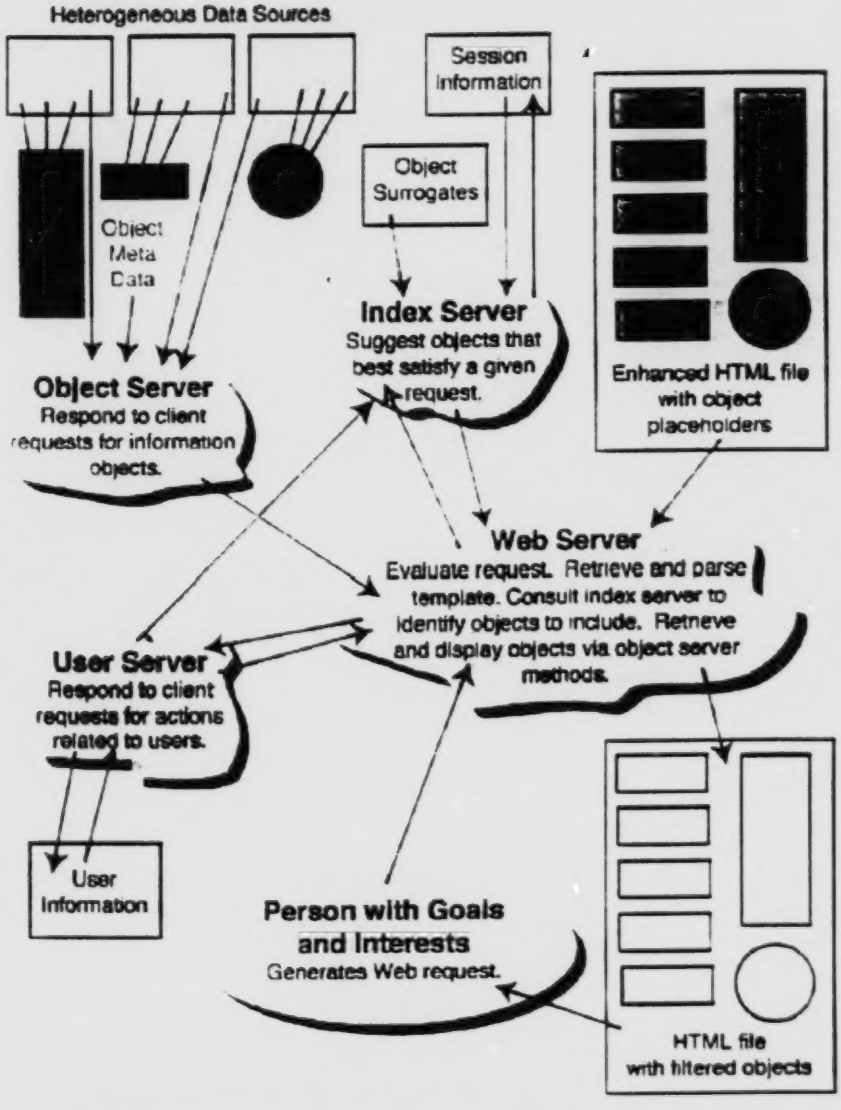
Heterogeneous Data Sources
Session Information
Object Surrogates
Object Meta Data
Index Server
Suggest objects that best satisfy a given request.
Object Server
Respond to client requests for information objects.
Enhanced HTML file with object placeholders
Web Server
Evaluate request. Retrieve and parse template. Consult index server to identify objects to include. Retrieve and display objects via object server methods.
User Server
Respond to client requests for actions related to users.
User Information
Person with Goals and Interests
Generates Web request.
HTML file with filtered objects

Figure 1: The System Components

Connecting to the Contents Page

When the user connects to the *Contents* page of the reference guide, the following interactions occur. As with the other requests, the Web server interacts with the user server to find out if this user is logged in and whether this user has a profile. The Web server gets the remaining request parameters including a template name in this case "contents. " The Web server reads in and parses the text file corresponding to the contents template. The Web server simply displays the lines in template file that do not correspond to object placeholders. For each object placeholder that it encounters, the Web server builds an index server request. The Web server asks the index server to supply a list of object IDs which best satisfy the request. The index server builds a query based on the request from the Web server. The query may incorporate user profile and goals information, object surrogates as context information, previous queries and also feedback from the user on how well previous queries performed. The index server compares its query with all of the

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object surrogates in the target class and builds a ranked list of object IDs to return to the Web server. For each ID in the returned list, the Web server gets the object from the object server and then asks the objects server to format the object for display according to the parameters given in the HTML template.

Results

One of the tests conducted measures whether the filtered system performs better than an unfiltered system. In this test, we calculated "time to complete a task" for both filtered and unfiltered systems, where the "task" was to find the answer to a question related to general Internet usage among the information sources that are included in the reference guide. The test subjects were students enrolled in computer literacy classes. In the first part of the test, the students interacted with an unfiltered system. Complete lists of tasks, examples, knowledge base items, related Web sites, and consultants were displayed, and the students looked through these to respond to the set of questions. In the second part, students interacted with SmartGuide using a predefined user profile set to the "UM Student/Internet User" stereotypes. In each part, the students were asked to answer five questions related to general Internet usage and to identify where the information was found (e.g., task or example id) in the reference guide. After the students answered the questions, they completed a brief attitudinal survey to measure subjective satisfaction with the system.

We found that students were able to find correct answers 22% faster in the filtered system. The average time to correctly answer a question was 198.84 seconds with SmartGuide and 255.77 seconds with the unfiltered system. Also students were less likely to skip or miss a question in the filtered system. The average number of skipped questions was 1.03 using the unfiltered system and .48 using SmartGuide. The average number of questions answered incorrectly was .63 using the unfiltered system and .23 using SmartGuide. The attitudinal survey responses were more positive for SmartGuide than for the unfiltered system.

While additional tests are planned to further evaluate this design, the outlook is good. The use of an object server supports the integration of information from heterogeneous sources into a unified interface. The index and user servers provide a filtering mechanism based on the user's background and current goals. The use of Java servlets with Apache enables the delivery of information through a Web interface. Finally, this design supports the automatic and dynamic generation of hyperlinks between related information objects, thereby freeing the developer of this task. The system components work together to achieve filtered Web views.

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A Method for User Verification

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Abstract: This paper addresses the issue of user verification in a multi-transaction session using HTTP and proposes a server side solution that does not require the cooperation of the client. A user initiates a request (a session) to a server from a browser and obtains a result through a sequence of transactions. The sequences of transactions have a linear order. Since HTTP is stateless, two problems arise. The first problem is to preserve the order of the transactions. The second problem is to determine that two consecutive transactions are associated to the same user. The first problem can be solved by imposing an order among the associated CGI programs. This paper presents a formal transaction model and proposes a solution to the second problem using hidden variables and time stamps. A user initiates the session by logging on to a virtual system. User verification is enforced as the session progresses for one transaction to the next.

Introduction

There are several applications that require multiple stages of input from the user where each stage depends on the previous stage. A simple generic example is a program that collects user input using menus. Usually menus may be organized as a tree. The response to a menu determines the new child menu to be presented. In such a situation, it is presumed that the user who executes the program is the one who is responding to the menus and retrieving the results. It is a safe assumption because the executing program is in control of all actions and its state remembers all relevant actions. This simple scenario becomes complicated in a WWW application because the http communication protocol is stateless. In order to present the problem in a clear and concise manner, an example is considered. Consider the case of an automatic bank response system which allows a user to obtain account balances and balance transfers over the telephone. In such a system, a user enters his account number and a PIN to get access to the system. Once the user gets access, he/she is presented with a menu of choices. For the sake of simplicity, let us assume that the top level menu presents two choices - obtain balance information and make transfers. The menu for balance information allows two choices - checking and savings. The menu for balance transfers also allows two choices - from checking and from savings. The third level gives two choices - exit or go back to the top level.

Assume that the above mentioned scenario is implemented using the WWW. Each menu will be presented as a form. The problem is to determine if the person who logs on is the one conducting the subsequent interactions. Such applications require a method to verify that the same user submits all forms. We formalize this problem by defining a formal transaction model. An illustration of the transaction model is shown in figure 1. In the next section we formally describe the transaction model. Based on the transaction model, a partial solution is presented.

Transaction Model

The transaction model is formally defined a 9-tuple (S, V, A, E, R, 1, 2I, s0, F) where

S: a set of requesting states
V: a set of verification states
E: a set of error states
A: a set of authentication conditions
R: a set of requests
1 : S R V
2 : A V S E

One state, s0, in S is distinguished as a start state (or login state). A subset F of S is distinguished as final state. The 's are called transition functions. A transaction is valid if it begins at s0 and ends in a final state by applying a series of transition functions. A transaction is illegal if it enters a state belonging to E.

Implementation

We use the above model to implement a user verification system in a WWW application. A state s in S is realized as a form. The authentication set A consists of a set of verification vectors (VV). A VV is a 4-tuple (u, p, h, t) where u represents a user id, p represents a process id, h represents history, t represents time. VVs are added and deleted as a transaction continues. A history h is a logical sequence of states traversed by the user. In other words a history represents a sequence of states beginning at start state and ending at the current state. The states s_i and s_{i+1} are in the sequence only if there is valid transition from s_i to s_{i+1} through an intermediate verification state v. The components u and p of a VV is used to identify a specific user. The components h and t are used to reasonably verify the user (u, p). The history represents the sequence of states visited by the user and t represents time at which (u, p) was in the previous state. The VV is recorded in the documents by means of hidden variables. A set of active VVs are also stored in the server side for verification purposes. If h_i represents the history at state s_i, then $h_i s_i$ represents the history at state s_{i+1}. If $VV1 = (u_1, p_1, h_1, t_1)$ and $VV2 = (u_2, p_2, h_2, t_2)$ are two verification vectors, VV1 < VV2 (or VV2 > VV1) if and only if $u_1 = u_2$, $p_1 = p_2$, $t_1 = t_2$, and h_1 is proper prefix of h_2. VV1 and VV2 are related if VV1 > VV2 or VV1 < VV2. All related verification vectors have an associated life time. (This relation captures the states that are reachable by using the "BACK" button in the browser.)

As mentioned earlier, a state is identified with a form (or document containing the form). The CGI program that gets the data from the form produces the next form. The verification conditions are checked by the CGI program. Let VV = (u, p, h, t) be the verification condition associated to the state and let T be the life time of verification vectors related to VV. If T+t is less than the current time, then the transaction enters an error state. VV and all related verification vectors are removed from A. In this case the user will have to start from the login state (start state). If T+t is greater than current time, it updates all related verification vectors by setting the t component to the current time. It also updates the set A by including a new verification vector (u, p, hs, t1) where t1 is the current time and s is the current state. This new verification vector is encoded in the new form produced by the CGI program using hidden variables.

Conclusion

In this paper we address the problem of user verification in WWW applications with multiple transactions. A formal model is described as an abstraction of the problem. Based on the model an implementation scheme is provided. Even though this scheme does not provide a fool proof solution, it provides an acceptable approximate solution. It does not use cookies [http://developer.netscape.com/find/index.html] and thus avoid client-side cooperation. It is a server-side solution using only CGI [Felton 1997] that can be implemented using hidden variables.

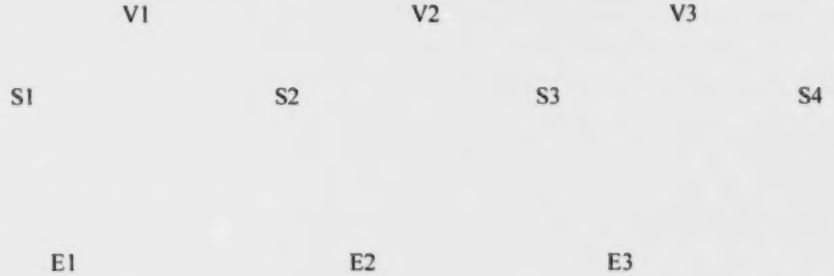

Figure 1 Transaction model.

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Reproduction of Hypermedia Lectures

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Abstract: German universities are overcrowded. Staff has been cut back, often resulting in poor quality teaching. Public infrastructure developers, on the other hand, try to instigate a market for contents transported via their networks. Among the inferentially sponsored projects is DIALECT - **D**igital **I**nteractive **Lec**tures, based at the Freie Universität Berlin and founded in 1994. DIALECT's interdisciplinary production team and authoring university teachers develop teachware-applications for students in regular base courses.
The first part of this paper introduces basic concepts and requirements of the DIALECT approach. Part two outlines DIALECT's framework and distribution approach for the world wide web. Part three discusses methods for presenting abstract and complex scientific content applied in a recently finished DIALECT lecture.

1. Introduction: DIALECT – A Modern Approach to Multimedia Lectures

1.1. The Project DIALECT - Digital Interactive Lectures

DIALECT lectures are designed as integral part of the courses. They do, however, not *require* human coaching. DIALECT lectures enable students to prepare and repeat courses on their own. Lecturers can also issue coursework drafts containing problems to be solved with the lecture.
DIALECT lectures require Windows® PC clients. The contained dynamic media may be stored locally or remote or streamed over the Internet via HTTP or other transfer protocols. Each client requires a sustained net bandwidth of 2 MBit/s. DIALECT lectures are employed by hundreds of students and professionals. Further information concerning DIALECT's general conditions, infrastructure, interdisciplinary teamdesign and didactic concepts can be obtained from [JENC7 96] and [ED-TELECOM 96] or visit DIALECT at

http://www.wiwiss.fu-berlin.de/dialect

1.2. The DIALECT Approach

An interactive video storyline encourages problem-based learning and serves as guided tour through the contents. There is no AI involved. Animations support the user in constructing his own mental models of the contents. Mere drilling of facts is not intended. DIALECT lectures ultimately require the learner to actively practice his knowledge in exercising components.
By adjusting the video storyline to the clichés and symbols of a specific genre, the user's *experience* with this genre can be invoked, thus tapping individual socialisation as information resource ([Barret 95], p. 68).
Thus advantage is taken of his or her existing knowledge. See also Apostolopoulos et al. in [JENC7 96], p. 272-1 to 272-9 and Bielenberg/Carpenter-Smith in [ED-MEDIA 96], p. 57 - 62. This approach is also in line with constructivist learning theory, stating that a learning individual is no empty container to be filled with knowledge by the teacher (condensed in [Schulmeister 96], p. 67 - 71). Learning is rather a continuous process, in which the learner - building on his individual experience - constructs his own worlds of knowledge. A mere collection of explicit facts cannot sufficiently explain reality.

1.2.1. Authors' Interface

University teachers' endorsement of DIALECT teachware is crucial for their acceptance with students. Therefore authors are tightly integrated into the development process and the DIALECT team has developed a screenplay-oriented scripting language helping to express their thoughts

1.2.2. Developers' Framework

In order to share newly developed features among all DIALECT lectures, a generic set of objects has been developed. Every DIALECT lecture is derived from this framework. Visual basic® has proven to be a reliable and flexible development tool for DIALECT's requirements. Numerous third party components have been integrated into the DIALECT framework. Leveraging the full extent of their features has become developers' major challenge. Media are maintained in a reference database. External media management and storage provide for easy localization.

2. DIALECT Framework and DIALECT-Distribution schemes

2.1. Modules of a DIALECT Lecture

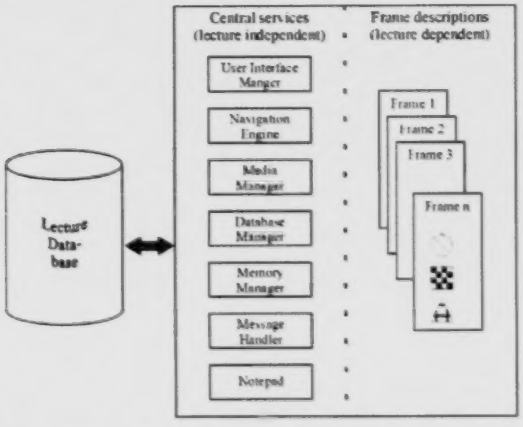

Figure 1: Conceptually different framework components

To keep the system adaptable to various kinds of contents the framework contains a lecture-independent central services component and a lecture-dependent frame descriptions component. As long as the above mentioned requirements to navigation and didactical approach etc. are kept constant, the central services components remain unchanged.

Navigation Engine / Lecture Database:
The navigation engine of the DIALECT framework fulfills two major tasks:

1. Providing an abstract description of each frame and its structural relation to other frames with respect to the construction of a knowledge space (sequence, hierarchy, mesh; authors may choose one or several structuring types). The selected structures are exclusively stored and managed in the lecture database.
2. During each user session the navigation engine sustains the correct user inference (jumps, branching, guided tours) through the knowledge space. This data is also stored externally in the lecture database, alleviating maintenance.
3. The lecture database contains the complete management for all session-relevant media data.

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The Frames:
The screens where the information is actually located are called frames. They represent the visible interface between author and learner. Starting from a coarse concept in a process of stepwise refinement the authors assemble the storyboards containing a complete description of the final frame. Those storyboards are then implemented by developers and layout professionals (concerning the production process, please refer to [JENC7 96], p. 272-5). Under perfect circumstances only frames have to be produced while the framework with its central services remains unchanged.

2.2. Distribution: DIALECT Goes WWW

The world wide web evolves fast. Software manufacturers, scrambling for market share, now favour proprietary solutions in the field of HTML-layout and authoring systems, database interfaces or component software (ActiveX vs. JavaBeans). New system architectures are established, often deliberately incompatible to those of other manufacturers. This undecided market situation prompts many developers to hesitate. Uncertainty over future runtime environments and over network access quality aggravates the problem.
Nevertheless due to the expanded scope of web authoring and website management DIALECT will also have to make its decision on development platform and runtime environment for future DIALECT lectures. The first step was to evaluate to which extent the current DIALECT framework could take advantage of a world wide web based distribution concept. Please note that the current implementation is IP based but not does not support HTML. This results from the framework's current requirement to access all media objects as DOS files. Such access via internet protocol could only be realised with NFS and the shortcomings of NFS in connection with continuous media are commonly known. This level of abstraction was sufficient as long as the framework operated on the basis of local file access (CD-ROM, hard disk) or as long as a high performing intranet provider was available.
Problems with 'Quality of Service' had to be addressed only conditionally in the past. Media access via WWW required the expansion of the logical concept of an *object* towards the *media stream*. On the one hand this had technical reasons as, for example, the HTTP protocol per definition transfers data as a record oriented stream of bytes. On the other hand the usage mimic of DIALECT lectures expects an instant playback reaction from continuous media. Users do not accept longer waiting periods. A complete distribution of DIALECT lectures via internet inferentially fails due to lacking guaranteed bandwidths and due to the widely differing quality of the multiple internet connections.

The framework would have to fulfill three major demands:
1. The media manager must be capable to retrieve data from URLs.
2. Data transfer must be possible via HTTP.
3. The presentation components of the user interface manager must be able to render *media streams* with some kind of instant playback.

Apart from the modified framework other problems arose:
1. *New media formats*
   Are the media formats currently used by the DIALECT framework capable of streaming? Do better suited formats exist with respect to performance and playback quality?
2. *Mediacaching*
   Once an internet stream has downloaded completely, should it be permanently stored locally, in order to avoid repeated streaming? Or are established WWW caching procedures (proxy) sufficient?
3. *Active media serving*
   As distribution of continuous media challenges every network, an active server support of the distribution process should be considered. Certain features stringently require active media servers.

media type	media format	manufacturer of third-party addon software (if applicable)
(Hyper-)Text	TXM ATX	DBS GmbH Bennet-Tec Corp.
Raster graphics	BMP, GIF	
Spreadsheet	VTS	Visual Components Inc.
Business chart	VTC	Visual Components Inc.
Video	MPEG	
Animation	AVI	(various codecs by several manufacturers)
Audio	WAV	

Table 1: The synopsis gives a summary of the media types and formats used in DIALECT lectures. Among these formats there are some proprietary ones. This is due to the character of our development environment, based on Visual Basic ®.

Of course AVI, MPEG and WAV can, like other formats, be distributed using HTTP. But the key question is, whether the user can start playback after the first few blocks have been transmitted. This depends on the media and file format. AVI marks an architecture that can incorporate any codec as long as certain interfaces are implemented. The separate codecs may apply very different approaches. Some codecs write certain index information to the end of their files. Such files definitely cannot implement instant playback. Unfortunately all previously used codecs belong to this category. An alternative had to be found.

New media formats:
We evaluated various file formats, e.g.:

1. *RealMedia (Progressive Networks)*
   This format serves for presentation of audio and/or video, optimised for low and middle bandwidth data transfer (14.4 Kbit/s – 300 Kbit/s).
2. *Flash (Macromedia)*
   The flash format serves to present 2D animation with synchronised audio. Flash animation is mainly vector based therefore requiring only low bandwidths.
3. *Indeo 5 Progressive Download (Intel)*
   Indeo5 has a MPEG style encoding algorithm, but is also appropriate for the display of animation. It trades relatively low scalable bandwidths for high demands to hardware performance.
4. *NetShow (Microsoft)*
   NetShow serves for the display of audio and/or video data, optimised for low transfer rates. A range of different codecs is supported.

Of course, each format has its own advantages and restrictions. But as long as the background drivers are integrated into the operating system properly the lectures should utilise the best fitting file format.

Mediacaching: Once a stream has downloaded completely there should be an option to store it permanently in local storage. This would secure further use and prominently the future availability for high performance playback. However this feature depends particularly on support by format specific client software.
In principal the evolution of leading operation systems converges to this requirement. Microsoft for instance has increasingly incorporated multimedia components into recent releases of its operating systems. One of them (ActiveMovie) allows for the HTTP transfer of formats like MPEG and AVI and their motion presentation. MPEGs can instantly be played back. Simultaneously a range of user interfaces (ActiveMovie player) and programming interfaces (ActiveMovie OCX) have been provided, assuring full programmatic control. But the function *saving to local hard* disk is not programmatical accessible.
Moreover employment of HTTP proxy servers can be considered. Proxy servers certainly offer advantages with respect to the exploitation of local resources to the maximum extent possible.

3. The DIALECT Approach Demonstrated on the Lecture IRS - Investment Calculus Subject to Taxation

3.1. Major Contents

IRS is a DIALECT lecture covering the impact of taxes on the classic investment calculus, consisting mainly of high-resolution animation. First an extensive survey to the German tax system is given. The survey is divided

into the personal taxes and the corporate ones. The following model for investment (*The Standard Model for Investment*) taught to students of business administration at the beginning of pre-graduate studies. The lecture aims to prepare the user for the examinations in *Finance and Investment*.

3.2. The Storyline

One basic concept of DIALECT lectures is to compensate for the lack of human communication by using an interactive video storyline. Our storylines contain an authentic problem, that can be solved with the provided knowledge. The storyline itself contains a lot of knowledge in its situated form. Furthermore, the story serves as navigational wrapper for the entire content, a feature heavily utilized by student-users.
In the IRS storyline a group of young friends start their career as employees of a blue-chip company. At first they encounter personal taxes. Then they get frustrated with the huge company's red tape and decide to found their own company. Having accomplished this, they tackle corporate taxes. Finally their flourishing enterprise comes under threat from their old employer and they have to consider a critical expansion investment. They have got to figure out, whether it is worth it or whether it is not while having to pay taxes ...

3.3. Animation

Animations make complex interactions visible and illustrate sample workflows. According to learning theory, animation can equally alleviate the construction of mental models by the users ([Weidenmann 94], p. 29 - 30). Learning theory also points out that animation requires "prior knowledge" of its elements. Therefore the constituting elements must carefully be introduced one by one.
Mental model animations may be displayed in three modes: indexed numbers, formulae or metaphors. The modes imply an increasing level of abstraction. So one might be blended over into another. Metaphors can display qualitative as well as quantitative interaction. Best fitted for the latter are obviously charts.
Learning theory also suggests, that appropriate pictorial metaphors significantly improve memorization ([Weidenmann 94], p. 37 - 39).

3.4. Active User Components

Numerous pedagogical and psychological papers explain that learning is an *active* process. Even if the user has understood a solution, he will soon forget, if he has not *actively applied* it. This implies the following requirements:

1. The user has to act; *continuously* and *independently*.
2. The user must have support available at every stage and in gradual levels.
3. The user must have checks on his learning. He must be able to determine, whether he is right or not.

The third item is easy to implement as IRS provides a host of control questions. To fulfill items one and two IRS contains a component called *Exercise*. Each task therein consists of a commented problem to be solved in a spreadsheet workplace. The user can act freely, but has commented sample solutions available at every stage. In between and final results can be tested for correctness. If he has made a systematic error the system can comment on his errors.
The *Notebook* feature of IRS supplies the entire content of the particular screen-frame as illustrated text in the right window pane. The left window pane contains a small wordproccessor. The user may now drag'n drop contents from the right pane into the left one, where he may edit them, annotate them, print them or export them to Rich Text Format. This feature enables the compilation of individual user records, encouraging active content reception. A complete set of frame scripts is also available.

3.5. Navigation

IRS contains various content-oriented means to navigate its knowledge space.

1. For beginners there is the storyline and the *Guided Tour*, a sequential order of screen-frames provided by the

authors.

2. Experienced users eagerly use the hierarchical content browsers and the glossary. The glossary lists every concept, gives a short definition of it and links the screen-frames containing the full scale explanation of it, thereby allowing encyclopedia-style browsing of concept references.
3. The *History* records the *individual* path of the user through the knowlegde space and includes a function *Back*. The browsers also indicate frames already visited.
4. The principle of content-based structuring is continued during media playback. Apart from the standard functionality (play, stop, jump) the user may direct the player to designated scenes and even sentences.
5. Media and screen-frames contain commented hyperlinks that alleviate association and repetition of related topics.

4. Conclusions and Results

Production

1. Productivity could be increased by about 50% compared to the previous DIALECT lecture, resulting in 0.5 to 1 man months per 'hour of learning material'. Expenses for video production tend to be overstated while those for animation tend to be underestimated.
2. Even with DIALECT's tailored framework university personel still requires specialists' support in transforming their contents into multimedia teachware.
3. Though improving, *sufficient* OS-support for multimedia will take another two years.

Evaluation

1. There are no objective and sufficient evaluation designs available yet for multimedia teachware. Past enquiries have to be put into the perspective of an ever changing technology environment.
2. We do not yet have enough information for a long term evaluation of video utilization. There is some evidence that video proves exhausting if used too lavishly.

Animating Mental Models

1. Descriptive, text-based explanations have to be restructured into animated visual models.
2. Knowledge elements and their interactions must be symbolized with application-wide metaphors.
3. Deliberate use of redundancy and repetition.

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New Architectures for Database Backed Web Applications

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Databases store information while the Web is the place for the gathering and distribution of information. However, there are inherent difficulties in linking them together. Nevertheless, real-life Web applications need an underlying database to be stable, flexible and scalable. Moreover, legacy database systems need to be connected to the Web. Consequently this poster introduces a new design methodology for the integration of databases and the Web, based on the finite state machine model well known from static hypertext documents. A Web based toolset helps to generate applications from an object based design language. On the client-side Java is compared with pure HTML. For searching, interfaces for both Software Agents and robots are provided. Using this techniques, complete multi-lingual, stable and robust real-life information systems have been built. The techniques presented on this poster will help to make the design of database backed Web applications faster, easier and less error prone.

Establishment of a Virtual Consultancy

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Abstract: Recently there has been an increasing interest in the concept of virtual corporations. The virtual corporation is envisioned by many experts as the solution for a quick introduction of a variety of high quality products at a low cost. But there are still some open questions and problems to be solved.

In this paper the SERVICE project (SMEs pilot for business process design in order to establish a virtual international consultancy using electronic commerce) is presented. The project is partially funded by the ESPRIT programme Technologies for Business Processes (TBP) from the European Commission and aims to build up a virtual consultancy (VC). The VC consists of partners from Germany, England, Greece, Sweden and Finland.

This paper presents work carried out by SIEM, Greece, in the context of the SERVICE project, towards the specification of the Virtual Consultancy Framework.

Project Objectives

The overall objective is to facilitate the participation of small and medium-sized companies (SMEs) in the global market by pooling their resources and exploiting the opportunities offered by the development of electronic commerce.

As SMEs cannot afford to build up their own corporate networks, they depend on the availability of public networks. Public networks can be used by SMEs to establish a virtual private network. Effective sharing of data and collaboration between manufacturing organisations requires technologies that are cost effective, flexible and portable. During the implementation of the pilot, support training, coaching and qualification measures are taken to verify the VC's efficiency and effectiveness.

The project itself provides for various, interesting items to be discussed. Following the baseline of the conference we will describe the overall framework intended to drive the Virtual Consultancy concept in SERVICE. This paper presents work carried out by SIEM, Greece, in the context of the SERVICE project, towards the specification of the Virtual Consultancy Framework.

The Basic Concept

The basic concept behind the Virtual Consultancy is the appropriation of the complementary skills of the user organisations toward a common objective (e.g. added value products and services) and the commitment to pooling such complementary resources together to facilitate the production of added-value services that would not have been possible by the individual organisations.

It follows therefore that in establishing the Virtual Consultancy there is a broad range of issues that need to be agreed starting from the resources that are to be pooled to defining the added-value products and services to be offered, the way in which they will be practically facilitated (e.g. pilots), the business models and workflows driving the operation of the Virtual Consultancy and the required software and ICT infrastructure needed to facilitate collaboration, co-operation and interaction with the parties involved.

To this effect, the proposed framework comprises several layers which provide the basic support for inter- and intra- communication and collaboration within the Virtual Consultancy.

Technical Overview

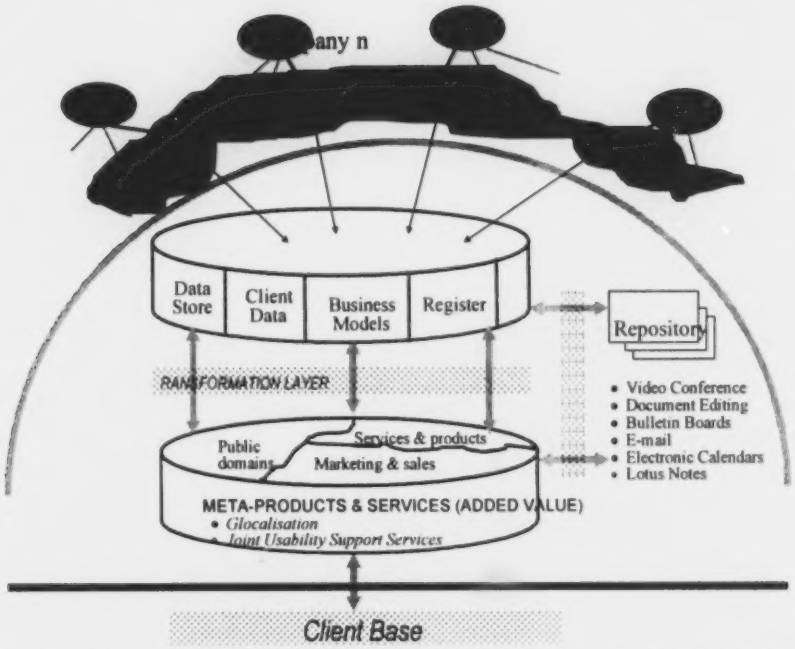

Figure 1: Virtual Consultancy framework

The basic technological ground of the Virtual Consultancy will comprise a suitable communications infrastructure (e.g. intranet, servers), software tools to empower the operation of the Virtual Consultancy (e.g. video conference, document editing, etc) and application software which will drive the inter- and intra-faces of the Virtual Consultancy. The following diagram serves as a guideline for discussing the concept.

The internal (or private) information Repository

As indicated in the diagram, there are at least two logical information repositories that constitute the basic software components driving the Virtual Consultancy. The upper information repository is private, and may in fact be realised as a meta-knowledge pool linking the user organisation's individual server sites. This Virtual Consultancy information repository contains data stores internal to the virtual organisation which can only be accessed via the Intranet. Within such a repository, a wide range of data are to be captured, including:

- *Resources* pooled together by the individual organisations. These are the "assets" of the Virtual Consultancy that have been deposited by each individual user organisation to facilitate the agreed aims and objectives. Such assets may vary in type, nature and scope.
- *Client data.* These are data primarily of a private and confidential nature, which will probably be of internal use to the Virtual Consultancy. Such data may reflect a range of client-specific details from financial and legal information to physical location, transaction histories, etc.
- *Business models*. These include representations of workflows and corresponding artefacts, such as processes, forms, etc., that need to be processed to accomplish an intended objective. Such models will also form part of the overall assessment of the Virtual Consultancy, as they constitute an important part of the re-engineered environment that will be created.
- *Registry* which will collect and structure the requests for Virtual Consultancy products and services. This capability can be conceived as a "living" document which summarises past events and provides a

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memory-aid for the Virtual Consultancy. Such a memory aid can serve a variety of purposes including access to past data, effective decision making, reuse of past experience, etc. Depending on its organisation and structure, it could provide an important knowledge management tool for the Virtual Consultancy.

The above categories of data stores are only indicative of the types that are considered essential for the operation of the Virtual Consultancy.

The public information repository

In addition to the private repository, the Virtual Consultancy should also possess a public counterpart which will be built around the repository, at the lower part of the diagram.

This component will facilitate a virtual presence of the consultancy and will comprise, amongst other things:

- *Public domains* for data and information exchange between the Virtual Consultancy and the external world (e.g. clients). These are designated stores which can be used by both the Virtual Consultancy and potential clients to exchange project-specific data. For example, a client may deposit a collection of user interface dialogues to be reviewed and evaluated by members of the Virtual Consultancy. On the other hand, such public domains may also be used by clients to review project status or download the results of a particular service contract.
- *Service* and *product* description to convey what the Virtual Consultancy can offer. This will be a conventional marketing tool for the Virtual Consultancy's offerings. It is expected that the client will be able to review specific assets of the Virtual Consultancy, outlines of products and services, as well as examples of good practice.
- *Marketing* and *sales* materials which may be in the form of design case studies, white papers, electronic catalogues and other communications. This facility, as indeed the previous one will provide the primary means of the Virtual Consultancy for attracting attention.

The transformation layer

The intermediate layer between the two repositories, referred to as *transformation layer*, entails all the "middle-ware" components required for knowledge management and inter-operability within the Virtual Consultancy. This entails the articulation of source data (captured into the private repository) into added-value products and services (deposited in the public repository) through inter-operable software components, as well as other tools for tracing past experiences, depositing new content, carrying out contract work, workflow management, etc.

Inter-operability is likely to be an important component of the electronic commerce side of the Virtual Consultancy. There are two issues related to inter-operability. The first is supporting tool inter-operability, which means that a particular tool used by a user organisation (such as Visual Basic) can process data produced by another tool.

The second type of inter-operability refers to complying with the specifications of different standards, such as EDI. Though both types of inter-operability are likely to become critical components of the Virtual Consultancy, in the short term inter-operability across different national, or prevailing European and international standards needs to be explicitly addressed as an important component of the transformation layer, so as to enable financial transactions between clients and the Virtual Consultancy. However, this constitutes a serious challenge, given the current trend of developing incompatible standards. Without such type of inter-operability, several disadvantages may be encountered, such as individuals or user organisations may become locked in specific solutions; it may be difficult to carry transactions between mutually incompatible systems; critical mass may be difficult to achieve, etc. It follows therefore that inter-operability should be an important concern when setting up the electronic commerce side of the Virtual Consultancy.

In conclusion, it should be mentioned that the transformation layer is explicitly separated from the tools repository on the right hand side of the diagram to denote the knowledge-intensive human activities that are still needed in order to produce the added value products and services from source data.

Interaction with the Client

Communication between the Virtual Consultancy and prospective clients may take place either through *e-mail*, *home page communication* by visiting its site, and making use of the Web-based application or *forum communication*. *E-mail* communication is the conventional means for sending messages from one place to another electronically. It is expected that it will be widely used to facilitate a broad range of communications amongst the members of the Virtual Consultancy as well as the Virtual Consultancy and the external world.

E-mail however cannot be used for more demanding electronic commerce functions. Instead, such activities are currently being undertaken by *home page* communication. In particular, at present most contracts are formed by a customer accessing a seller's home page and selecting goods. In the case of the Virtual Consultancy, clients may access the Virtual Consultancy through the Internet by visiting the site, which a Web-based application residing within the public repository of the Virtual Consultancy. Clients may visit this site either to retrieve information or deposit requests for services or contract / project-specific data to be further processed by the Virtual Consultancy.

It is important that the virtual presence of the consultancy should provide clients with service descriptions by content rather than name (e.g. what can be done), example case studies, marketing and other sales materials, as well as tools for raising requests for contract work. In order for such seamless communication between the Virtual Consultancy and its client base to be realised, several security mechanisms will need to be in place.

Finally, *forum communication* refers to the case where one person or organisation posts a message on a special interest bulletin board which is read by others. It should be mentioned that this form of communication is suitable for casual and informal communication as opposed to formal business transactions. The Virtual Consultancy should possess this capability, as it is likely to meet the need to communicate or make announcements to special interest client groups in addition to home page announcements.

Electronic Commerce in the Virtual Consultancy

One important aspect of the Virtual Consultancy which has implications on the ICT infrastructure and the business models to be developed, relates to the type of electronic commerce that is envisaged and the type of interactions that need to be facilitated (e.g. inter- and intra-communications).

In this context, and in contrast with traditional electronic commerce involving business-to-business transaction, the Virtual Consultancy will appropriate Internet-based electronic commerce. The main differences between traditional electronic commerce and the Internet-based commerce envisaged for the Virtual Consultancy can be summarised as in the following table:

Traditional electronic commerce	Internet-based Commerce
Business-to-business only	Business-to-consumers
	business-to-business
	business-to-public administration
	user-to-user
Valued-added networks (VAN)	Internet
Security part of the VAN	Security and authentication needed
Known and trusted partners	Known and unknown partners
Local to the involved industries	Global scale

Table 1: Electronic Commerce

From the table, it follows that the Virtual Consultancy will increasingly need the means to support a wide range of transactions (e.g. traditional *business-to-business*, as well as *business-to-consumers*, *business-to-public administrations* and perhaps *user-to-user* transactions) in a global market. The main conclusion from the above is that whereas in the traditional electronic commerce the market was basically a closed club, in

Internet-based commerce it is the entire network that constitutes the market. This of course has implications on the business models to be developed and the ICT infrastructure that should be in place in order to drive the operation of the Virtual Consultancy. In addition, it raises a range of considerations regarding liaisons with intermediaries that offer specialised added-value services, such as for example, information brokers, courier, delivery and distribution services, catalogue aggregators, banks, etc..

Summary

We describe the overall framework intended to drive the Virtual Consultancy concept in SERVICE. At the core of this effort is to highlight the process re-engineering which will allow individual companies to stream line operations, so that the Virtual Consultancy reaches the required levels of effectiveness and efficiency. In addition, the proposed framework as described, offers a logical overview of the concept and ICT infrastructure that is needed to realise the operation of the Virtual Consultancy.

Jamming.Net: a Server to Balance WWW Load

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Abstract: A common problem with hypertext information servers is that they suffer high load of requests. Jamming.Net is a multithread server, written in Java, which performs a switching on the incoming HTTP connections by using the user-preferred policy of balance. Consequently, Jamming.Net is able to share load among a set of conventional web servers, both commercial and public domain, improving performance and reducing latency. Jamming.Net runs without problems on every machine with JDK version 1.1. Tests are performed on Solaris, NT, Linux.

1 The Need of Distributed Servers

A need for advanced solution to manage high load traffic is necessary, as the WWW increases in size and complexity. Today, the most common solution is to have got a unique web server running on a very powerful machine with great capacity of memory, fast processors, low access disk array. This way to face the problem is somewhat limited because the solution is not much scalable. In fact, as soon as the volume of traffic increases, it appears the need to modify the hardware configuration of the machine running web server. There are some cases in which we are even forced to change hardware at all. Beside, this solution is not fault tolerant. If there is some hardware problem in the machine, or software failure in HTTP server, the WWW service stops to work and published information are no more available on line. Here we are identifying three needs that modern system should meet in order to publish information:

- **Network Scalability**: We want to preserve the used hardware architecture and add only a new HTTP server running on a different machine, if the incoming traffic to an existing HTTP server increases.
- **Load Balancing**: Keeping in mind the previously described scenario, we want to share traffic among this set of HTTP servers according to some policies which depend on local load or some pseudo random heuristic.
- **Fault Tolerance**: In case of fault of one of these servers we want to be able to recover, stopping to use it

and, at the same time, replacing it with one of alive servers automatically.

2 Jamming.Net: a Server to Load Balance Existing WWW Servers

Keeping in mind these three needs, we developed a software server architecture that tries to satisfy them. One more need we want to satisfy is not to build another web server; in fact commercial and public domain servers exist with many features in term of programmability (server side script, module extensions and so on..) and with many tools dedicated to manage them. So, we develop a program acting in front of pre-existing set of HTTP servers, each one eventually running on different computers. In fig. 1 we have the position in network architecture in which Jamming.Net is placed. Like a traditional www proxy [1], Jamming.Net is situated between a www client (the browser) and the information content provider. Compared to a www proxy the marked difference is that Jamming.Net is able to decide what HTTP server has to provide the answer for every incoming request, on the bases of local information. Moreover Jamming.Net is transparent to the www client, in fact there is no need to configure the browser in order to use it.

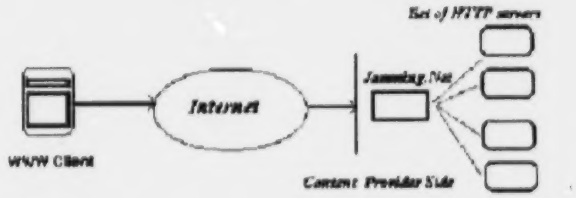

Figure 1: The position in network architecture in which Jamming.Net is placed.

2.1 Java Multithread Architecture

To Build this kind of architecture we decide to use Java [2] as developing language; it grants us desirable features such us portability, object oriented programming, general network API and multithreading. While portability allows us to run Jamming.Net on the most common platform (both Unix and NT), O-O Programming allows us a clear prototyping, finally network API programming and multithread allows us to gain benefits from lightweight process and BSD-like network features [3].

Inner server architecture is described in fig. 2. It consists of many threads. A subset of them lives forever and provides general functions such us management, periodic fault discovery, handling of incoming connections. Another subset is created dynamically for every incoming connection and only lives for the duration of same connection. We can explain it in detail:

- One *Listening Thread* that listens to the incoming connections from www clients, creates a new thread to handle each of them, choosing a www server to serve them, among the configured set. Since now, we call *worker* a HTTP server in the configured set. The method of choosing a *worker* is a matter of balance, and we are going to talk about it later.

- A set of *Switching Threads*, each one created dynamically by the listening thread when a new HTTP connection arrives. They take the job to both *store & forward* both all HTTP packets moving from the

assigned www client to the chosen worker, and all answer from the worker to the client. In this way, they die as soon as there is no more data to handle.

- One *Control Thread* listening to commands given via an ad hoc developed applet. In fact these commands are used to modify the server's state in real time (balance policy, workers' type, fault-tolerance). We are going to talk about Jamming.Net management later.

- One *Sampling Thread* which exploits periodic network's sampling in order to discover a worker's fault and runs with low priority.

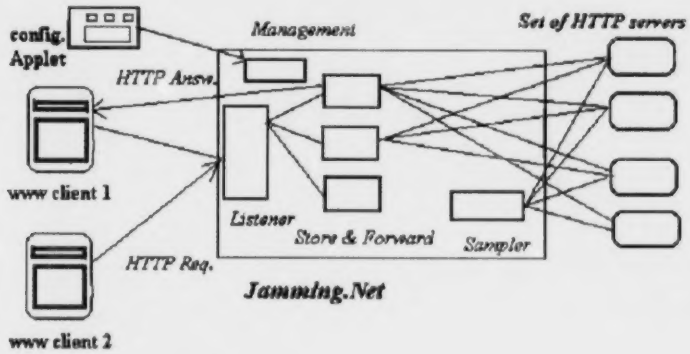

Figure 2: Jamming.Net server architecture

2.2 Balancing Policy and Network Scalability

Inside Jamming.Net, load balancing consists in choosing which worker serves incoming requests, *dynamically and for every single HTTP connection.* This technique is more useful than HTTP Redirect or DNS Balancing methods [4] because it gives the administrator an high control level of the load generated by each WWW requests. In fact, HTTP Redirect performs a redirect to another web server only for the first incoming connection. All subsequent requests go directly to that server. DNS Balancing has a lot of problem well described in [4]: above all, it shows poor fault tolerance and poor balancing in case of spot traffic.

Jamming.Net implements three balancing policies in order to let the listener thread choose which worker serves the incoming request:

- *Round Robin*: for every incoming connection, next worker in modulo is chosen.

- *Uniform Random*: a worker is chosen basing on a generated uniform random number.

- *Origin IP Hashing*: given the IP address of WWW client (the browser), a worker is chosen by applying a hash function on it. Consequently incoming connections from the same machine are always served by the same worker, by using this technique.

Network Scalability is simply reached enlarging the set of HTTP servers acting as workers. This could be exploited via the management applet, without performing any Jamming.Net reset. So, when traffic goes over a threshold, a network administrator could preserve the existing hardware and software installation.

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2.3 Fault Tolerance

Fault tolerance is the set of techniques used by the server to discover the failure of a worker. Implemented techniques are grouped in two classes:

- *Synchronous Sampling*: as seen before, a worker is selected when a www connection is arriving, basing on the chosen balancing policy. If it happens that a worker does not answer before a time-out threshold, a fault condition is raised. This kind of testing is synchronous; in fact it depends on both www client request and chosen balancing policy.

- *Asynchronous Sampling*: as seen in architecture schema, a sampler thread stays alive with minimum priority. When a threshold time arrives it choices a worker, produces a request and waits for an answer. If it does not come, then a fault condition is raised. This kind of testing is asynchronous since it does not depend on www requests originating from clients.

If a fault is raised, some strategies of recovery could be exploited:

- *Worker Remove*: the worker is removed from the list of those available, and another available worker is selected.

- *Administrator Notify*: the event of worker's fault is notified to the administrator. He / She could decide what to do to recover from fault.

2.4 Security

Some security controls are performed by server:

- *Time-out on Listener side*: a system of time-out is exploited on listener thread in order to avoid that incoming connections with no HTTP request could cause a waste of resources.

- *Network address verifying*: when a new worker is inserted in the set of those available, Jamming.Net performs a control that it has a valid network address, and that there is a www server on the given port. This is to prevent an erroneous configuration.

2.5 System Cache

In order to reduce communication latency for small TCP-IP connection, a simple LRU cache mechanism was introduced in Jamming.Net. Each store & forward thread accesses cache concurrently by using a mutex mechanism. The cached data are stored in local file system and mapped in memory by means of a hash table. It is possible to configure data TTL, maximum dimension of cached data and maximum cache dimension. By adopting a very small cache substantially improves the achieved performance.

2.6 Workers Architecture: Replication or Shared File System

As we know workers are machines running a WWW server. There is the possibility to adopt two strategies in order to maintain the content of these servers. The information published could be:

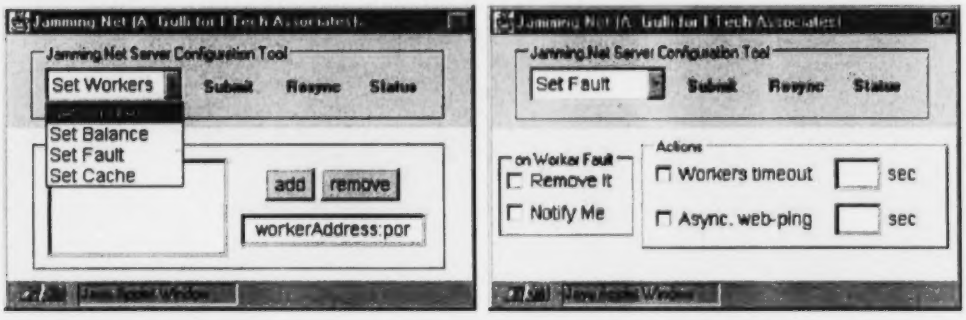
- *Replicated*: for example on a Unix System using the "rdist" [5] features
- *Shared*: for example on an Unix System using NFS or AFS [6], on NT System via SMB [7]

Workers could be placed on the same LAN of Jamming.Net server or, improving performances, on a dedicated LAN. In such cases, the machine running Jamming.Net must act as a router for this auxiliary LAN. We can note that in these architectures Jamming.Net could act as a simple firewall.

3 Management Applet

The whole server configuration is performed by using an applet written by using JDK1.0 and consequently running on most common browsers. It is possible to modify the inner configuration of Jamming.Net without stopping and restarting the server, by using the applet. We can see a subset of the applet's tabbed panels in fig. 3, they are used to group together server functionality:

- *Workers' Control*: this panel gives to the administrator the possibility to modify the workers' set known by Jamming.Net.
- *Balance Technique*: this panel allows the administrator to select the balancing policy used by Jamming.Net
- *Fault Panel*: this panel permits the administrator to select what to do if a worker fault is raised, what kind of sampling to perform (synchronous and/or asynchronous) and to choose sampling intervals.
- *Cache Panel*: this panel permits the administrator to configure and to manage system cache, to choose maximum occupation allowed in file system, maximum file dimension and data TTL.



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Interactions with server are performed by using three buttons. The *Submit* button submits to the server the choices selected in the applet. The *Resync* button loads from server the actual configuration. The *Status* button loads the server's status (number of faults and statistics).

4 Current State of Work and Future Work

Currently, we have a working system that meets the requirements described above. Jamming.Net is used to share traffic on a test bed architecture composed of three workers running Linux on a bi-processor Pentium with Apache[8] used as HTTP server. We are testing what is the maximum throughput reached by the distributed architecture under different load conditions, different dimension of data requested and different balancing policy. Jamming.Net's code is available on request and the executable was accepted by Java Application Catalyst Italia (maintained by Sun Italy), Gamelan (maintained by Developer.com), JavaToys and JARS. We believe that this work could point out the general need to move from an unique information server to a scenario of distributed servers' set.

5 Acknowledgments

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[5] Distributing files remotely over TCP/IP, http://obgyn.umsmed.edu:457/NetAdminG/rdistN.rdist.html

[6] Transarc AFS Documentation, http://eis.jpl.nasa.gov/afs/transarc.com/public/www/Public/Documentation/afs_doc.html

[7] SMB Resources and Information, http://www.ns.aus.com/smb-res.html

[8] Apache's site, http://www.apache.org

Technological Support for Apprenticeship

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Abstract: Apprenticeship is an appealing alternative to traditional lecture- based classrooms, but is difficult to implement within traditional undergraduate classes. We propose the use of Web-based technology to support an apprenticeship, particularly, support for collaboration and modeling of process. We present two tools that serve these roles: CaMILE which provides for anchored collaboration, and STABLE which provides models of successful project process. Evaluation results are positive, showing improvements in discussion length, student performance on projects, and student learning.

Apprenticeship, and its developing variant cognitive apprenticeship [Collins, Brown, & Newman, 1989], is an appealing alternative to traditional lecture-based classrooms. In an apprenticeship, the master (teacher) supports students by demonstrating techniques, coaching students while they use the techniques, and provides the students with the opportunity to explain what they do to others [Guzdial, 1995]. Cognitive apprenticeship is about applying the apprenticeship structure to help students learn modern cognitive skills such as mathematics and reading–or even design, but avoiding some of the negative connotations of apprenticeship. Demonstrations and coaching works well with small classes (e.g., perhaps 25 students) in K-12 where students have more than 50 minutes per class period. To make cognitive apprenticeship work for *large* undergraduate classes where time is *short*, we are using technology to extend the reach of the teacher and support the student designing and learning outside of the lecture hall. Apprenticeship, in a sense, is all about creating connections between teachers and students and students with one another. The technology discussed here helps to create these connections.

At Georgia Tech's College of Computing, we teach a sophomore-level class that introduces students to object-oriented design and programming, CS2390 *Modeling and Design*. Over the last four years, we have developed a successful curriculum and software supports which enable us to provide students with an apprenticeship-like experience within the constraints of a traditional classroom (e.g., 40-75 students per quarter, three lectures a week, one lab a week, one instructor and three TA's). This paper presents highlights of the technological supports provided to students. The next section is a brief overview of what educators and cognitive scientists have learned about the critical aspects of apprenticeship learning. I then present two of our tools, STABLE and CaMILE, and the evaluation of each of these in CS2390.

Critical Aspects of Apprenticeship Learning

Cognitive apprenticeship was developed to focus traditional classrooms on tasks rather than abstract concepts [Collins et al., 1989]. By supporting students in learning in the context in which it might be used, the odds are increased of avoiding "brittle knowledge" [Brown, Bransford, Ferrara, & Campione, 1983], where students can pass tests but never use the knowledge in real-world situations.

There are several pieces to a successful cognitive apprenticeship. Three key pieces that we try to create in our class are:

- *Focus on Tasks over Concepts*: Rarely do apprentices learn something because they *might* use it one day. They learn to complete tasks. Learning is not abstract, and its results can be seen in the current design.
- *Scaffolding*: Scaffolding describes the kind of supports that a master provides when students are learning: Demonstrating and explaining the process, coaching the students as they work, and encouraging them to talk

about what they're doing [Guzdial, 1995]. An important aspect of scaffolding is that it *fades* – it's not at the same level for all students, since different students have different needs.

- *Community*: Apprentices learn in a community at all different levels — younger apprentices to be helped, older apprentices to model yet-to-be-learned skills and knowledge, and one or more masters to demonstrate and coach. A community provides the opportunity to demonstrate and articulate knowledge, which is key for students' learning in an apprenticeship [Blumenfeld et al., 1991; Redmond, 1992].

Technology to Support Apprenticeships

We created two pieces of technology to facilitate the creation of apprenticeships in learning object-oriented design and programming:

- *Case Libraries for Scaffolding*. STABLE (SmallTalk Apprenticeship Based Learning Environment) is a case library [Kolodner, 1993] of prior students' projects. STABLE is a task-focused form of scaffolding (e.g., demonstrations of how to design) with some adaptability. STABLE makes connections between more-expert students and their more novice peers.
- *Integrated, Anchored Collaboration for Community*: CaMILE (Collaborative and Multimedia Interactive Learning Environment) is a Web-based collaboration tool which features the ability to embed a discussion in another artifact, an *anchor*. CaMILE is effective for supporting, and even encouraging, extended connections and teaming. In our studies, we have found that anchored discussions in CaMILE tend to be longer (while still on-topic) than unanchored, newsgroup discussions, which suggests that discussions are more sustained and potentially more valuable in the anchored setting.

Case Libraries for Scaffolding

STABLE provides students with step-by-step description of several projects, most of which are projects completed successfully by prior students. STABLE is a form of demonstration, and also serves as a form of community–a communications mechanism between senior students who have taken the class before and leave behind records of what they did and how.

- *Hyperlinked to a variety of resources*: Each project is organized into a hierarchy of steps, which includes analysis steps, design steps, and programming steps (Figure 1, left). All steps are linked to multiple representations of the project, e.g., a tree representation of the entire current project, or a Coad-Yourdon diagram of the project's class structure.
- *Linked to relevant concepts and generic steps*: Abstract lessons are presented in STABLE in the context of a task [Fig. 1] (left). When a step addresses an abstract *concept* (such as "What is a part-whole relationship?"), a link is made to a separate page that presents the concept. Sometimes a step is demonstrating an action which occurs very often, for example, building a graphical user interface. The step might then also link to a *generic step* page that presents the generalized form of how to build a graphical user interface.

A form of fading scaffolding: A step is actually presented at three or four levels of detail [Fig. 1] (right). Students are initially presented with the least detail, but they can request more information if they need it. Additional information about the step is often available, such as *strategy* information (why is this step being done now and in this way, a common piece of information requested by apprentices [Redmond, 1992]), *outcome* information (a test for whether the step was completed correctly), or *repair* information (what are the common mistakes in this step). [Fig. 2] presents a step at its lowest level of detail, simply the statement "Build the DivisorCount Class" (which was analyzed and designed in earlier steps). By asking for More Detail, the student can increase the scaffolding and receive more-and-more support for how to build the DivisorCount class: first a paragraph description, then an outline of the code, and finally the code itself.

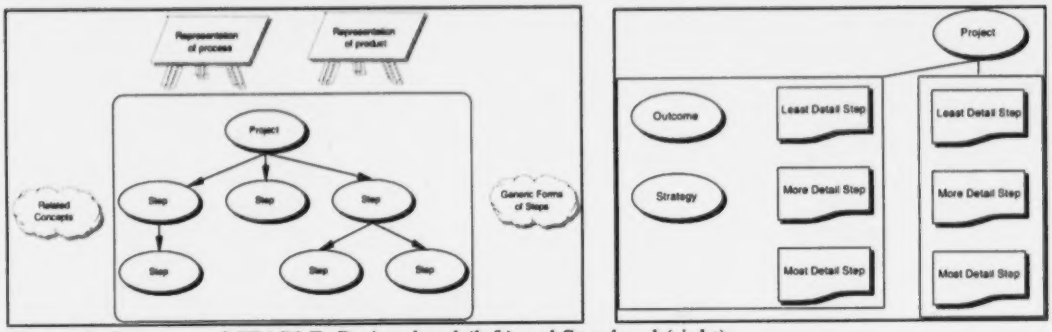

Figure 1: Structure of STABLE: Project level (left) and Step level (right)

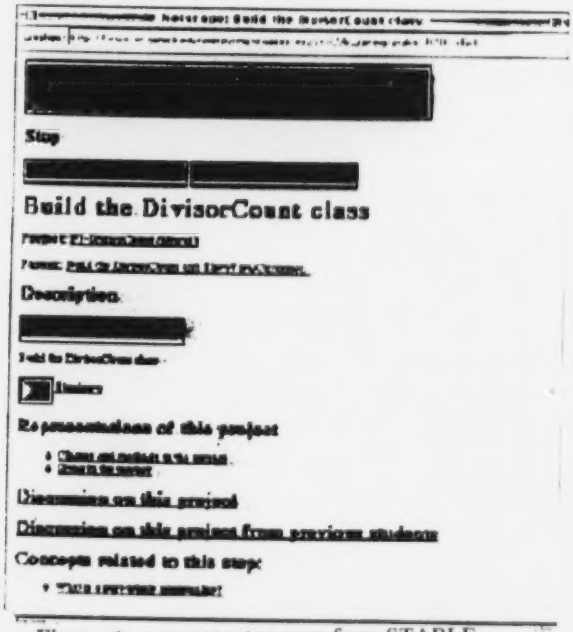

Figure 2: A sample step page from STABLE

STABLE currently contains over a dozen projects which total to almost a thousand Web pages. (STABLE is generated from a database containing pieces of the case library information.) Several of the projects are from the same class addressing the same problem assignment, to show students trade-offs and alternative ways of solving the same problem. We do not yet have negative examples, but are considering adding them. Our focus is not on providing examples of artifacts, but examples of process — how a project develops from analysis through design to implementation.

The CS2390 curriculum has changed to take advantage of STABLE. For example, there are three cases that address the problem of creating a simple spreadsheet constraint mechanism, which was the second assignment during the Case-Gathering quarter (Winter '96). In STABLE-using quarters, I asked students to extend the original projects. One quarter (Spring '96), I asked students to extend the spreadsheet constraint mechanism, and another quarter, I asked students to wrap a more sophisticated graphical user interface around the simple spreadsheet. In both cases, the spreadsheet problem was now the ***first*** assignments of the quarter—we have been able to move the class more quickly through reliance on the case library. Students are always offered the opportunity to reuse any of the code from any of the STABLE case, but the reuse was not required.

One of my evaluations was to compare the performance between the Case-Gathering quarter (Winter '96) and a Case-Using quarter (Spring '96). If students were using STABLE to good purpose, one would expect that the Spring students would be more successful at their problem (using the same grading criteria and same graders), building on the

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previous students' work (even though they were getting a problem of greater complexity earlier in the quarter). However, if they were not using STABLE, one would expect lower performance. The results in [Tab. 2] show that students using STABLE performed with a reliably better overall grade than did the original Case-Gathering class.

	Winter '96 Class (Control)	Spring '96 Class (STABLE-using)
Winter Second Assignment vs. Spring First Assignment	75.6 (stdev 31.8)	85.8 (18.3) (p=0.03)

Table 2: Performance Comparison between Case-Gathering class (Winter'96) and Case-Using class (Spring'96) on a similar problem

The important question is whether students learned more about design from STABLE than they did previously: Does it help to have students read and reuse a set of object-oriented design problems? To test this question, I created isomorphic problems (similar but not identical) from the Case-Gathering quarter's final exam. I created an isomorphic design problem and graded using the same scheme with the same graders Both problems were graded the same. [Tab. 3] summarizes the learning results. STABLE-using students did significantly better on the design problem.

	Winter '96 Final Exam (Control)	Spring '96 Final Exam (STABLE-using)
Design problem	0.83 (stdev 0.21)	0.91 (0.14) p=0.02

Table 3: Learning Comparison between Case-Gathering class and Case-Using class on the Isomorphic Design Final Exam Problems

We believe thát STABLE is being successful at helping to create an apprenticeship-like environment, leading to improved object-oriented design learning. In addition, students are improving their performance. Students are learning and improving performance through use of STABLE (as advice from former students) in the same way that junior apprentices might learn from and be more successful at a project with help from a more senior apprentice.

Integrated, Anchored Collaboration for Community

CaMILE is a tool for encouraging students to work with one another, to explain to one another what they're doing and why, and to help one another be successful and learn in the same manner as a communities of apprentices. In our work with CaMILE in a variety of contexts, we've found that that's not an easy goal [Turns, Guzdial, Mistree, Allen, & Rosen, 1995].

- Simply forming teams of students can lead to disaster. While some small groupwork is effective, team projects can go awry leading to poor performance, little learning, or both [Turns, 1996].
- Providing newsgroups may be the right kind of tool, but there may be little or no incentive to use it.

CaMILE is a Web-based threaded collaboration tool that offers features that prompt students to collaborate effectively and structures collaboration to encourage learning [Guzdial et al., 1996; Guzdial, Turns, Rappin, & Carlson, 1995]. A particularly important feature of CaMILE is that each individual note has its own URL, which allows us to create links from any document on the Web to a particular thread in a CaMILE discussion. (A thread is a series of related notes. If note A comments on note B, and note B comments on note C, we say that notes C, B, and A are all in the same thread, and that C has a thread length of 3.) For example, I can post a Final Exam review with problems from prior final exams [Fig. 4] and provide a link from each problem to a CaMILE thread for student answers to that problem [Fig. 4]. CaMILE facilitates *anchored collaboration*, and by properly choosing anchors (to be interesting, motivating, and encouraging discussion), we have found that anchored collaboration can help to generate in-depth discussions. Other anchors we have used include design assignments and student projects (for peer review).

To measure our hypothesis, we compared the newsgroup usage (unanchored, since few newsgroup readers allow individual note addressing) in the Fall '95 CS2390 class and the CaMILE usage (some anchors, though many threads were not linked to an external Web page anchor) in the Winter'96 CS2390 class. The two classes were taught by different instructors, but had the same textbooks and nearly identical curricula (e.g., even some of the same slides were used in each class). [Tab. 3] summarizes the results of the comparison.

- A broader distribution of students utilized CaMILE versus the newsgroup, suggesting that the anchors helped to broaden the appeal of the collaboration support.
- The CaMILE-using class wrote many more notes with nearly as many top-level threads as in the newsgroup, so it is not surprising that the average thread length is longer (7.2 versus 1.9).
- Anchored threads (those pointed to be external Web pages) in CaMILE are much longer (average 56 notes long) compared to unanchored threads in CaMILE (average 2.5).
- We have done a qualitative analysis which suggests that in neither the newsgroup class nor the CaMILE class were notes off-topic. Most notes were about class issues (e.g., "What's a class?") or on homework assignments.

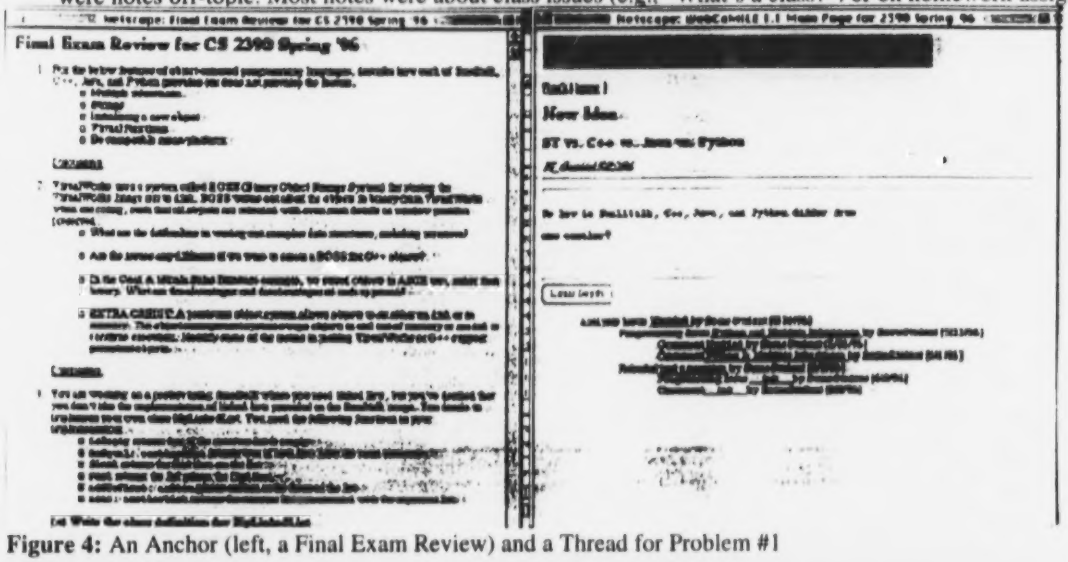

Figure 4: An Anchor (left, a Final Exam Review) and a Thread for Problem #1

	Fall '95 (Newsgroups)	Winter '96 (CaMILE)
Number of students	49	75
Number of authors	23 (47%)	59 (79%)
Number of notes	119	493
Number of threads	64	68
Average length of thread	1.9	7.2
Ave. length unanchored	N/A	2.5
Ave. length anchored	N/A	56

Table 3: Comparison of a Newsgroup-using CS2390 class and a CaMILE-using CS2390 class

The results for CaMILE suggest that an anchored approach – giving students something to talk about – can be effective for generating deeper discussions. CaMILE can be a useful tool in creating the kind of community seen in successful apprenticeships. We have not measured learning with and without CaMILE, but our sense is that the community-building aspect improves both motivation and learning.

Summary and Future Directions

STABLE and CaMILE are two tools which are helping to create the advantages of a cognitive apprenticeship for Sophomore computer science students at Georgia Tech. STABLE provides a form of scaffolding that fades, particularly scaffolding that demonstrates effective design process. CaMILE creates a forum for community-building, where students can explain what they're doing and help one another.

Our believe is that apprenticeship is a useful pedagogical model for object-oriented design instruction. It informs us about the kinds of supports that we need to provide to students. That we are getting good design learning and creating an apprenticeship structure with such young students speaks well of the structure and of the kinds of supports that we are providing.

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Home Network Management Using Internet Management Protocol

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Abstract: The advent of the digital multimedia revolution has created the need for high-speed digital network connecting consumer electronic devices in home environment. In large-scale home network environment the management and operation of many digital consumer devices become very difficult and complex task. Clearly an efficient and consistent framework for home network management is required. SNMP, the most famous Internet management protocol, provides an appropriate management model for home networks. This paper discusses our proposed design of IEEE1394-based home network management architecture using SNMP.

1. Introduction

IEEE1394-1995 is IEEE standard for a high performance serial bus supporting both isochronous and asynchronous transfer modes. For example, digital VCRs or DV camcoders can communicate with a digital TV using MPEG2 transport streams and the control packets over the IEEE1394 high-speed serial bus.

This paper describes IEEE1394-based home network management architecture using SNMP (Simple Network Management Protocol), with which we can implement configuration, security, fault and performance management. In the architecture, a set-top box or a PC on home networks does not only act as a manager of digital consumer devices but also acts as a gateway between the Internet and home networks.

2. Home Network Management Architecture

2.1 Manager

The manager system sends SNMP requests (e.g., GET, GETNEXT, SET) for accessing managed objects to managed devices and receives results (see [Case et al. 1990] and [Stallings 1993]). Then received results are calculated to appropriate values and displayed in various formats. The manager system also acts as a gateway between TCP/IP-based Internet and IEEE1394-based home network. Thus users can manage digital devices connected to home network from outside of their home environment via the Internet (see [Fig. 1]).

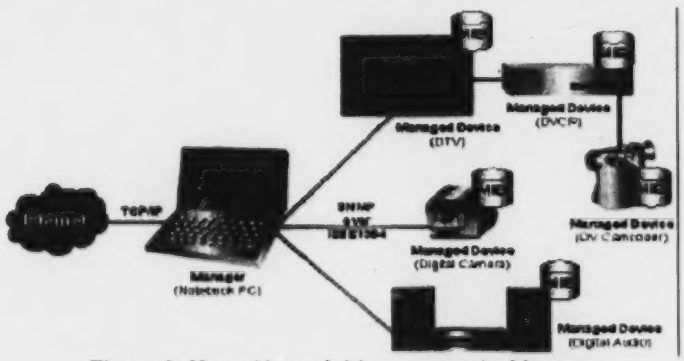

Figure 1: Home Network Management Architecture

2.2 Managed Devices

The managed devices are IEEE1394-compliant [IEEE 1995] consumer electronic products in which a real-time

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operating system, a SNMP agent and their own MIB (Management Information Base) are embedded. The following shortly explains important components of managed devices (see [Fig. 2]).

2.2.1 Embedded Real-time Operating System

The Real-Time Operating System (RTOS) embedded in managed devices provides execution environment for SNMP agent process and provides APIs to control hardware such as IEEE1394 port and CSR (Control and Status Resisters) [IEEE 1994] on managed devices.

2.2.2 SNMP Agent over IEEE1394

Implementation of SNMP agent over IEEE1394 needs IP layer to be implemented over IEEE1394 [Johansson 1998] using embedded RTOS API. The API must include following functions:

- READ_FROM_PORT, which reads IEEE1394 port and stores incoming bytes into buffer
- WRITE_TO_PORT, which writes contents of buffer to IEEE1394 port
- LOCK_PORT, which locks IEEE1394 port

2.2.3 Home Network Device MIB

MIB is a database of managed objects accessed by network management protocols, and uses tree architecture to organize all available managed objects (see [Rose and McCloghrie 1991]). Each managed object of home network device is mapped to corresponding CSR using RTOS API. The API must include following functions:

- GET_CSR, which gets value of specified CSR
- SET_CSR, which sets value to specified CSR

For example, SNMP GET or GETNEXT request for any managed object on MIB tree invokes GET_CSR function for corresponding CSR and SNMP SET request invokes SET_CSR function.

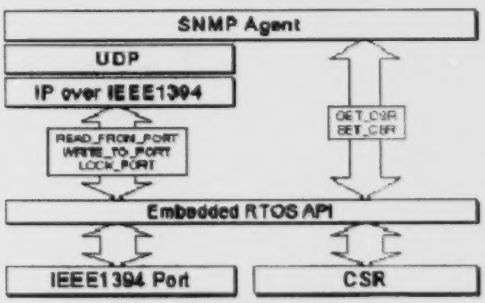

Figure 2: Managed Device

3. Conclusions

Proposed architecture provides consistent and efficient methods for home network management by embedding most popular and common network management protocol SNMP in managed devices.

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Guided Surfing: A Multimethod Assessment of a Layered Hypermap WWW Interface

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Abstract: A multi-level hypermap interface was created for the display of world wide web pages relevant to an undergraduate class in Sensation and Perception. Assessment of the interface consisted of two experiments. Results indicated that the guides encourage students to broaden the focus of their search. Further, the guides do not appear to be particularly effective for enhancing the acquisition of detailed-factual knowledge. Over all, students subjective reactions to the guides were positive. In particular, they perceived the guides as making the search project more efficient, and providing the learner with "big picture", conceptual knowledge.

1. Background

There is no question that the World Wide Web offers great potential as an educational tool [Anderson & Joerg 1996]. This resource is so new that educational researchers have had little time to examine it, however, research which has been conducted indicates that it can serve to enhance learning. The web seems to be particularly effective when used as an adjunct to, as opposed to a substitute for, more traditional instruction [Goldberg 1997]. A second important finding is that hypermedia environments in general [Jacobson et al. 1995] and the web in particular [Anderson & Joerg, 1996] are most effective when the learner is given some degree of structure or guidance.

With this in mind we set out to develop an organizational tool for displaying relevant web sites within a given subject domain. In our case, we selected Sensation and Perception, since the principal investigator regularly teaches a class in this area, and since there are an extensive number of web sites available [Krantz 1998]. However, we believe that this methodology and our findings are potentially applicable to other domains beyond Sensation and Perception in particular, and Psychology in general. The method that we used was an extension of previous research on two-dimensional knowledge displays called knowledge maps. Knowledge maps are a method of displaying text in a two-dimensional node-link network. (Maps used in the present experiment can be viewed within the Guided Surfing Program). This technique, which was developed by Dansereau and colleagues [Lambiotte et al. 1989], has been found to be more effective than traditional-linear text displays [Hall & O'Donnell 1996]. In particular, the method is effective for imparting higher-level conceptual knowledge [Hall et al. 1991].

We assessed the interface on two different methodological levels. First, we conducted a controlled experiment in which students were randomly assigned to groups, and the hypermap display method was compared directly with a traditional-linear display of web pages. Second, the hypermap guide was examined within the context of a Sensation and Perception class, in which students were required to carry out two class projects using the hypermap guide and corresponding web pages.

2. Experiment 1

2.1 Method

2.1.1 Participants

Twenty Students, enrolled in either General Psychology, Theories of Learning, or Theories of Motivation at a medium sized, midwestern, science and technology oriented University, participated in experiment 1. Those in the General Psychology Class participated as a regular part of their class, and those in the other classes participated outside of the regular class time, for extra credit in the class.

2.1.2 Materials

Site selection. The first step in development was the selection of appropriate web sites for a Sensation and Perception class. An outline for the class was developed and then a number of search engines were used, and many web pages examined, and eventually a set of seventy-five web sites were selected, within four broad categories: vision, audition, smell/taste, and somatosensation. These

sites were selected based on five criteria:1) The site was relevant to the framework of the course as specified by the instructor; 2) The site tied the basic information to be learned in the course to "real life", "meaningful" information; 3) The information contained in the site appeared to be accurate, as determined by the class instructor/domain expert; 4) The information was presented in an interesting way, making effective use of the hypermedia tools available to the site developer; 5) In the case of sites that were relevant to what the instructor considered "core" concepts, a number of sites, which presented different perspectives/representations of the information, were often selected.

Guide Development. The guides consisted of a series of knowledge maps. The domain expert/first author constructed these maps by forming categories of the web pages, based on the class outline, and on the nature of the sites selected, and then noted interrelationship among groups. From this, ten different guide maps were constructed. The vision and smell/taste groups of sites were each represented by two levels of maps - a map, and more specific "sub-maps". When a students clicked on a node on the main maps a second, more specific map would appear on the screen. All of the other nodes on the maps served either as place keepers to aid in the accurate representation of the information displayed within a given map, or were a direct link to one of the seventy-five World Wide Web Sites selected. Audition and somatosensation sites were represented by a single map. The program can be viewed at:
http://www.umr.edu/~rhall/class/sap/sapsurfprogram/surfprogramindex.html

2.1.3 Procedure

Students first read a set of directions displayed on the screen. Students were randomly assigned to two conditions. Ten of the students then studied the selected sites for thirty minutes using the guide maps, ten studied the sites using 4 different guides which listed the links for each of the four highest level categories (i.e., vision, audition, smell/taste, and somatosensation), in an outline format.

After studying, students completed an essay from memory covering the information they studied. They then completed a questionnaire, presented on the computer, including specific questions, with Likert scales, and one open ended question.

2.2 Results

2.2.1 Essay Scoring

In order to determine the amount of information that was included in students' essays, each essay was broken down into a set of factually accurate propositions, each consisting of a simple declarative sentence. This scoring technique is based on a technique developed by Meyer [Meyer 1975]. The number of propositions included in each student's essay served to represent the accurate amount of information contained. Reliability was established by having a second experimenter score a random subset of 10 (50%) of the essays. The reliability between the this scorer and the original scorer was $r = .90$. Neither scorer was knowledgeable as to the group assignment of the student essays as they were scoring.

2.2.2 Propositional Analysis

A t-test for independent samples was carried out with experimental group (map vs list) as the independent variable and propositions recalled as the dependent variable. The mean difference between the groups on number of propositions recalled was not statistically significant.

2.2.3 Questionnaire Responses

The analysis of questionnaire responses consisted of a series of two-way repeated measures analyses with experimental group serving as a between subjects independent variable, questionnaire items as within subject independent variables, and students responses to the questionnaires, serving as the dependent variables.

2.2.4 Site Category Visited

The questionnaire analysis began with a two-way repeated measures analysis of variance. Group (map versus list) served as a between subjects independent variable, and the first four questionnaire items (time spent on: vision vs audition vs smell/taste vs somatosensation), served as a within subjects independent variables. Students' ratings served as the dependent variable.

No significant effects were found.

2.2.5 Focus of Search

In order to examine how focused vs broad the students' rated their searches a two way repeated measures analysis of variance was computed with group (map versus list) as a between-subjects independent variable, and questionnaire items #5 & #6 ("My search was very focused..." vs "My search was very broad...") serving as a within-subject independent variable, and ratings as the dependent variable.

A significant main effect was found for focus, $F(1, 18) = 17.03$, $p < .01$. The descriptive statistics for the within-subject variable were $M = 6.45$, $SD = 2.67$, and $M = 2.60$, and $SD = 2.19$, for focused and broad search respectively. A significant group X focus interaction was also found, $F(1,18) = 5.82$, $p < .05$. The means associated with this interaction are displayed in [Fig. 1].

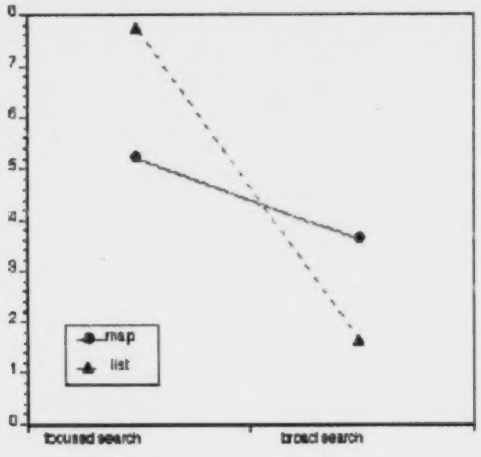

Figure 1. Questionnaire rating as a function of Group and Focus

2.2.6 Effectiveness of Guide Pages

Questionnaire items #7, & #8 ("I found the guide pages, helpful ..." "for learning" vs "...for helping me to get an overview) served as a within subjects independent variable in the third, two-way, analysis of variance. Group (map vs list) again served as a between-subject independent variable.

No significant effects were found.

2.2.7 Affect

Lastly, a two-way repeated measures analysis of variance was conducted to examine students mood while studying. Questions #9 & #10 ("I found the ... studying to be a positive experience" versus "I was anxious and nervous as I studied the web pages.") served as a within subjects independent variable, group was the between subjects independent variable, and ratings were the dependent variable.

A significant main effect was found for affect, $F(1, 18) = 20.354$, $p < .001$. The means and standard deviations for the "positive experience" versus "anxious and nervous" items were $M = 7.2$, $SD = 1.74$ and $M = 3.4$, $SD = 2.18$ respectively. No other effects were significant.

2.2.8 Students' Open Ended Responses

In general, with respect to the guides, those who were in the map group had more positive comments. Some representative comments are displayed below.

Hyper Map Group

- The guide pages helped to make the huge amount of information more manageable. It was helpful to have fewer choices and to narrow down the subject.
- I found them to be very effective in helping me to find information I wanted. The nodal guides were effective in localizing my searches.
- I liked the guide pages because you could see how everything was connected. It let you see everything that was associated with one major topic.

List group

- I found the guide pages to be fairly helpful, although I mainly just stumbled upon the topics that I thought to be the most interesting.
- Some of the guide pages were not helpful simply because I did not know what some of the things listed were
- Personally, I found the guide pages to be only somewhat helpful. I used the guide page to find a basic topic and only went back to it if I ran out of links, or at least interesting links.

3. Experiment 2

3.1 Method

3.1.1 Participants

Fifty-eight students from two section of an undergraduate sensation and perception class at the same University participated in experiment 2 as a class
requirement.

3.1.2 Procedure

During the semester students were required to carry out four web projects spaced out equidistant across the semester. Each project was worth approximately 3.5 percent of their total grade (14% all together). Each web project corresponded to one of the four sections of the class. For the first two web projects students were required to go to certain web pages, read and carry activities and answer specific questions about the pages.

The last two web projects were the focus of this experiment. In both projects students used the guided surfing interface. On the first guided surfing project they were asked to focus on the vision and audition sites, since these were more relevant to the information they were covering in class at the time, and, on the second project they were asked to focus on the smell/taste and somatosensation sites for the same reason. After studying the sites students were required to email an overview to the instructor, on which their grade was determined. They were also required to complete a Likert-style questionnaire, and were asked to supply open-ended comments about the guided surfing interface.

3.2 Results

3.2.1 Questionnaire Item Factor Analyses

The analysis began with two factor analyses, one performed on items for each questionnaire. These were principal components analyses with a varimax rotation. In both questionnaires, the same items neatly into a four factor solution. The factors were: a) Guide effectiveness; b) Category concentration (in the first questionnaire, high scores represent concentration on vision, as compared to audition, and in the second questionnaire, high scores represent concentration on smell/taste vs somatosensation); c) Breadth of search; and d) Experience with computers and the world wide web.

3.2.2 Factor Score and Test Correlations

Factors scores were created by averaging the items included in each factor (after reversing the scoring of items with a negative loading). A series of Pearson correlations was then computed between each questionnaire item for the first guided surfing assignment, and scores on test 3, which was the test that corresponded to the section of the course (section 3) that was most related to those web pages, and that was given after the first guided surfing assignment had been completed. None of these correlations were statistically significant.

The same set of correlations was then computed between questionnaire items on the second questionnaire and students' test 4 scores. The correlation between category concentration and test 4 was significant $r(46) = .378$, $p < .01$. (The greater the concentration on smell/taste, as opposed to somatosensation sites, the higher the test score.) No other correlations were statistically significant.

3.2.3 Comparison of the Two Web Projects

In order to compare students' responses to the third (vision and audition) versus the fourth (smell/taste & somatosensation) web projects, a multivariate analysis of variance was computed with Web Project (3 versus 4) serving as a within-subject independent variable. Each questionnaire factor, and class test scores served as the dependent variables. A significant overall multivariate effect was found, $\Lambda = (4,38) = .0078$, $p < .001$.

This was followed by a series of with-subject t-tests with section serving as the independent variable and each questionnaire factor, and test serving as the independent variable. Statistically significant mean differences were found in the "guide effectiveness", $t(41) = 3.12$, $p < .01$; "category concentration", $t(41) = 2.69$, $p = .01$; "breadth", $t(41) = 3.18$, $p < .01$; and class tests, $t(57) = 5.04$, $p < .001$ analyses, and no significant difference was found with respect to www/computer experience. The means and standard deviations for the statistically significant t-tests are displayed in [Tab. 1].

factor/test	project 3		project 4	
	M	SD	M	SD
guide effectiveness	6.82	1.74	7.58	1.02
*category concentration	6.04	2.30	7.30	1.72
breadth	6.60	2.10	5.20	2.10
class test	72.00	16.75	81.29	11.20

*high scores represent vision sites concentration on project 3 and small/taste sites on project 4

Table 1: Questionnaire factor scores and class test scores as a function of Web Project

The last analysis was a within subject t-test comparing students' response to questions 11 and 12, which were only included on the second questionnaire. High scores on question 11 indicated that students found the fourth web project sites (smell/taste and somatosensation) more interesting than section three (vision and audition), and high scores on question 12 indicated that they found the organization of the fourth project's guide more effective than the third project. The mean difference was statistically significant, $t(47)$, = 3,14, $p < 01$. The means and standard deviations for interest and organization respectively were $M = 6.23$, $SD = 2.19$ and $M = 5.17$, $SD = 1.69$. Students found the section 4 sites more interesting, as opposed to finding the guide more organized.

3.2.4 Open Ended Responses

An examination of student's responses to the open ended question yielded three general themes:
1. The majority of students felt positive about the guides in both projects. They felt the guides enhanced the efficiency of the searching, and aided the students in getting an effective overview of the information. 2.Those students who did feel negative about the guides felt that they were confusing, and that it was too easy to get lost. 3. Students preferred the second guided searching project to the first, as evidenced by references they made to the first project on their second project comments. This was also evidenced by the fact that virtually all negative comments were associated with the first section, and virtually none were made with regard to the second. Representative comments follow:
Experiment 2 Representative Responses to Open Ended Questions

Positive Responses to Guide:

- I have had some experience in trying to find information on certain topics, and this way of presenting the information is a great deal better than could be done by listing links vertically. By presenting the information in a hierarchy, and showing how the links are interrelated seemed to facilitate incorporating the information from the different sources.
- I don't think I could have easily or as effectively found as much information without the guide.

Negative Responses to Guide (all from fourth web project:

- I found them to be confusing and hard to keep track of the links. A simple outline or table of contents at the beginning would serve the exact same purpose and probably be more effective.

Comparison of the two projects:

- I thought this one was more interesting than the visual one, that is probably because of my own personal interests ...
- I was so interested in the smell and taste that I didn't even think about looking into the somatosensation pages.

4. Conclusions

The first conclusion that emerged from these two experiments was that the guides appear to broaden the students' search focus, and, this in turn leads to the student forming a better conception of the big picture. This conclusion is based on student's subjective responses to questions about focus in the first experiment, in which the map guide was compared to a traditional list, and in questionnaire responses and open ended responses in experiment two. As one student put it, " I found your guided

surfing outline to be effective in organizing the information ... for conceptualizing it I think your approach is better.".

A second conclusion that can be drawn is that the guided surfing interface doesn't appear to aid students in recalling factual information. In experiment one, the interface was no more effective than a traditional, linear method of listing web pages, in effecting propositional recall. In the second experiment there was no relationship between the degree to which students found the interface effective, and their scores on related class tests. This may be partly explained by the first conclusion, in that the guided surfing interface may be most useful for imparting the general conceptual information, as opposed to factual details.

A third conclusion which was consistent across both experiments, and across both projects included in the second experiment, was that students perceived the guided interface to be effective. This was most obvious in their open-ended comments about the guides. They found the guides to make searching efficient, and, as mentioned, they perceived them as being particularly effective in providing broad domain knowledge. This finding adds further support to the contention that the maps may best serve instructional purposes when the aim of the instructor is to provide the students with broad knowledge about a domain. With respect to the World Wide Web, this would be particularly important to an instructor whose goal is to give the learner an overview of the web sites available within a given area, in order to facilitate a more efficient search.

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How To Bring Cooperative Structures And Hypermedia Into The Field Of Technical Mechanics ? - Our Experiences

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Abstract: One important objective of cooperative structures, workgroup computing and intranet/internet technology is to intensify the interaction between the source and drain of information. Workgroup computing, e-mail and all forms of collaborative learning are technologies to intensify the coordination and communication of an organization. The following paper will show our special experiences, the social and organizational effects on introducing the new hypermedia and workgroup technology into the field technical mechanics at the University of Paderborn, Germany.

History of GroupWare and hypermedia in the laboratory for technical mechanics

The age of computer supported collaborative group activities started in our labs about three years ago when the use of electronic mail and of a network connecting all personal computers was considered. Early activities such as the simulation software "KARL" which was written in FORTRAN express the need for the development of software to archive, document and to discuss our experiences of physical and mathematical experiments.

Many smaller simulation tools, database applications and mathematical engineering methods (e.g., finite elements) were developed as FORTRAN routines in order to solve daily problems in the field of traditional mechanics. The next step was to use these smaller simulation and animation software systems for the teaching of mechanics to our students. The huge number of students did not allow to perform the necessary amount of real experiments as it would be necessary to give students a thorough understanding of complex mechanical effects (e.g., the technique of caustics or holographic methods which are used to determine stress intensity factors in experimental fracture mechanics).

Therefore, one objective of an animation software, which was originally developed in FORTRAN, was to enable students to understand and master the complexity of modern mechanics by considering the interaction between the various different physical parameters involved. At that time nobody used the terminology multimedia, but these animation software systems fulfilled nearly all definitions of today's multimedia animations ([Rad70]).

The next step was to integrate animation systems of this kind into hypertext as part of a learning system, or an interactive mechanics lecture. However, it took some effort to reach this goal since many attempts failed when various hypertext formats were used, ranging from Windows Help format to HTML 1.0, and which did not fulfil the need to handle the extensive amount of mathematical formulae and complex graphics used in engineering.

Nobody was able to convert expressions developed in TeX, or with the Microsoft Word Formula Editor, into Bitmap Format to include them into hypertext systems with acceptable effort. Therefore, no concrete system for everyday use in the teaching of mechanics could be established. The people who teach mechanics at our institute did not perceive the new media as being too complex to use and to develop, and accepted them fairly easily. Parallel to this effort, the local intranet of our university was more and more used to exchange scientific data between the various scientist at the different laboratories, but the aforementioned co-operation resulted from shared file systems without any underlying structure, and the security levels and structures of access rights were provided by the UNIX operating system.

Approximately one year later first experiences with the Hyper-G hypermedia environment developed by Maurer [AKM95] were made. This was the first system that allowed us to use postscript as hypermedia text format. By setting up this system it became possible for the first time to use standard tools for the development of hypermedia text versions of papers and tutorials. Scientists at the laboratory for technical mechanics could use their favorite office systems, such as Microsoft Word and TeX, to create electronic versions of their documents.

Now, students, tutors and lecturers were able to exchange documents with the help of the Hyper-G system by using special clients called Amadeus and Harmony. We integrated our animation systems into the Hyper-G system, used a Hyper-G supported "generic" data type, included small video clips and presentations, and soon the first cooperative version of the *mechANIma* system was born ([FeHa96], [FeHeHa96], [FeHe96].

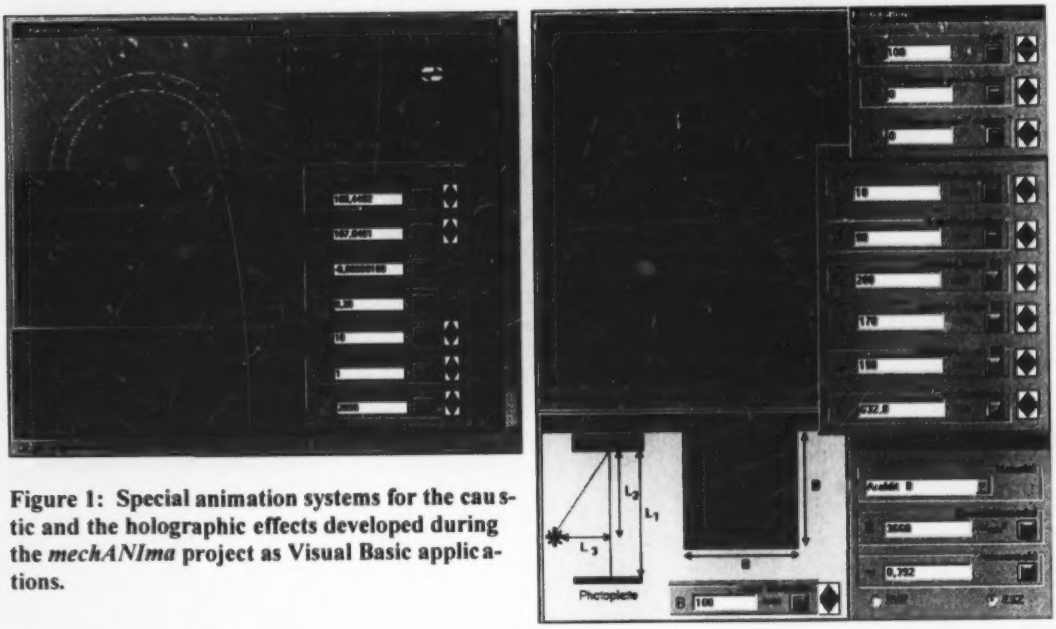

Figure 1: Special animation systems for the caustic and the holographic effects developed during the *mechANIma* project as Visual Basic applications.

Experiences how to visualize technical mechanics

One important observation we made was the fact that the development and daily use of hypermedia materials has to be easy and intuitive enough, so that tutors and lecturers are able to concentrate on their real work; the development of new media should not become the main focus of their attention. The same effect we found in the development of visualizations. The use of highly interactive and visual programming languages, such as the Microsoft Visual Basic system or the Borland Delphi Programming Environment opened up opportunities for non-professional programmers, such as students of technical mechanics, to visualize their concrete science-work,

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e.g., experiments in the field of holographic or caustic stress-determination (Figure 1). Our goal to work mostly with easy-to-use tools in order to develop hypermedia resulted from the fact that we tried to influence and to include as many members of our lab as possible in the development process by acknowledging their individually different understanding in the use of multimedia and workgroup techniques. Many different internal Hyper-G courses and multimedia-workshops which were held on a regular basis helped to establish the new technologies in many parts of the mechanics courses. One interesting observation was that many tutors and lecturers did accept new media, and even expressed the willingness to use them, but were not able to bring them into a state of daily use due to the pressure of time and resources.

Experience shows that in non-computer science environments, such as our laboratory, a potential user will only accept easy and intuitive to use applications with a graphical user interface. Scientist and students only produce hypermedia documents if they are able to use their normal office or graphic applications in order to compose them. Consequently, we looked for other possibilities to generate electronic versions of the various mathematical mechanics papers. Eventually we found that the Adobe Portable Data Format (PDF) was the best to use for our needs. The PDF format was easy to generate being implemented as an low level printer driver for the Windows system. Now lecturers could use their favorite word processor to generate a PDF version of the document which was easily published on the Hyperwave server. Students who have access to this intranet server can download and even print entire documents. The main part of our students still prints the hypertext papers and tutorials found on our hypermedia server in hardcopy version, as no continuous access to the new media can be guaranteed ([BrKeil+97]). As it was mentioned by Keil-Slawik students should have a continuous access to hypermedia data during lectures, at home and in tutorials to accept electronic versions of documents as an alternative to classical paper. Hyperwave enables students to have continuous access to the latest release of electronic documents. Errors and typos which are found in lecture or tutorial manuscripts can easily be corrected and published on the information server. Printed versions require much longer turn-around times. It is even possible to let students put their homework on the server and discuss it in later tutorials. This concept called "learning-supporting infrastructure," introduced in [BrSchSe97] and [BreKeil97] of collaborative learning with the help of integrated teaching and learning environments, satisfies many requirements to achieve more flexible forms of combining individual and social learning processes.

For the same reason we produced a CD-ROM for our students which consists of a complete collection of helpful and illustrated course material, such as all necessary mechanics papers, complete dissertations, many exercises and a lot of small Visual Basic and Delphi animation and simulation software. The interesting fact is that for many students and members of our institution an updated version of this CD-ROM often forms the starting point to participate in our collaborative work and intranet activities. It seems that people who are no daily users of cooperative environments first have to explore a clearly defined and limited part of the hyperspace, such as the one provided by the CD-ROM, in order to find out about their individual needs. The next step is an active participation in collaborative learning environment, such as our Hyperwave based *mechANIma* server.

Current hypermedia activities in the field of technical mechanics

Our present activities in the use of new media for education lead in two directions. First, we currently evaluate and test tools and methods for an easy-to-use development of hypermedia documents and animation applications. Second, we try to integrate all media into a collaborative hypermedia environment, such as the Hyperwave system. The Hyperwave information server meets our immediate needs since it offers several features which do not belong to the usual web and intranet servers. As an object oriented data base Hyperwave stores various hypermedia documents, links and document attributes to provide automatic link consistency. It dynamically indexes text and custom-made document attributes and, consequently, provides easy access to information. But the most important point is the capability of a user and group management system which results in the possibility to limit control access to the server, the documents, links and structural elements based on user authorization and sophisticated access rights. These multi-user features of the Hyperwave system allow students to work together simultaneously and to collaborate in the further development of hypermedia documents. On the *mechANIma*

hypermedia system every member of our institution gets his own personal collection. An normal front end such as a common Web browser is easy to use, even by non-computer experts. Hyperwave offers the advantage to let people develop their personal hypermedia and offers an interactive way to load documents up to the server.

Our basic concept to use highly interactive visual programming environments in order to create small visualizations and simulation programs is the only solution to the idea to let students develop multimedia applications individually and independently.

We claim that it is impossible within the restrictions of human and financial resources to develop high quality hypermedia applications without cooperation at work. Our main goal is the development of design principles for coordination, distribution and, thus, sharing of work. As mentioned before we used Visual Basic as the first easy-to-use programming environment. Experiences show that students who have no programming skills at the beginning of their work are satisfied by the swift progress they make with Visual Basic and by their productivity. Mechanics students who get a short, two day introductory course to the programming techniques need about three weeks to produce their first small visualization systems. Consequently, the hypermedia development is achieved directly by the user. Naturally we are not able to produce such high quality products as commercial developing systems where the help of professional computer scientists becomes imperative. However, in the field of non-commercial use we do not need such professional systems. How do we define a "professional" system? The crucial point is that a system which supports cooperative learning has to be current and up-to-date. Our research activities in the field of technical mechanics change very rapidly. Therefore, students have to adapt to new requirements more or less immediately. Hence, the user has to be an ongoing participant in the design of lectures, tutorials and hypermedia materials. We are not alone in our decision to apply collaborative structures for the development of hypermedia materials.

Recent work on the field of statics (course A on technical mechanics) by two of our students indicate that they were able to produce interesting illustrated course material in due time. Other students and lecturers were surprised how easy and illustrative this first mechanics course could be presented. We are very encouraged by these early experiences. Students who design hypermedia have proven to be very efficient to grasp the necessary tools and expressed their individual views on the underlying mechanical background. One of our students (fifth semester) even developed small Java applets for the illustration of beam deflection curves. She integrated digital video, hypertext and data-base functionality to form a hyperspace drawing and to present a more or less complete overview on this subject. One goal of this particular project was the integration of different tools, e.g., common office word processors like Microsoft Word to generate HTML hypertexts. Students were able to use their favorite systems and formula editors to write the basic text material. They used a digital camera to produce small video sequences of the lecturer explaining key aspects of the topic. Common WYSIWYG Hypertext-HTML editors were used to implement the hyperlink structure. In the next step these materials were integrated into our Hyperwave information system with open access to all students. Hyperwave like version management and annotations are the necessary prerequisites for a lively discussion of the hypermedia materials.

As discussed previously we have produced a CD-ROM which includes all hypermedia documents. Despite the fact that many course materials already include small animations, programmed with the help of Visual Basic, we developed our own Netcsape plugin which allows to execute Visual Basic applications. In other words, any hyperlink of the hypertext documents can point to an animation. However, a potential disadvantage of this procedure, namely its limitation to Microsoft Windows platforms which use Windows Programming environments, such as Delphi or Visual Basic, is not crucial for our application. More than 90% of our students own Microsoft based Windows PCs.

A second benefit is the popularity of such systems. Students get an extreme amount of information, code fragments and example programs through the internet and literature.

Java applets as animation systems for the teaching of mechanics

Recent work on Java development environments focuses on the design of applets to illustrate complex mathematical relations. Our main criterion when choosing one of the available design environments is their degree of usability.

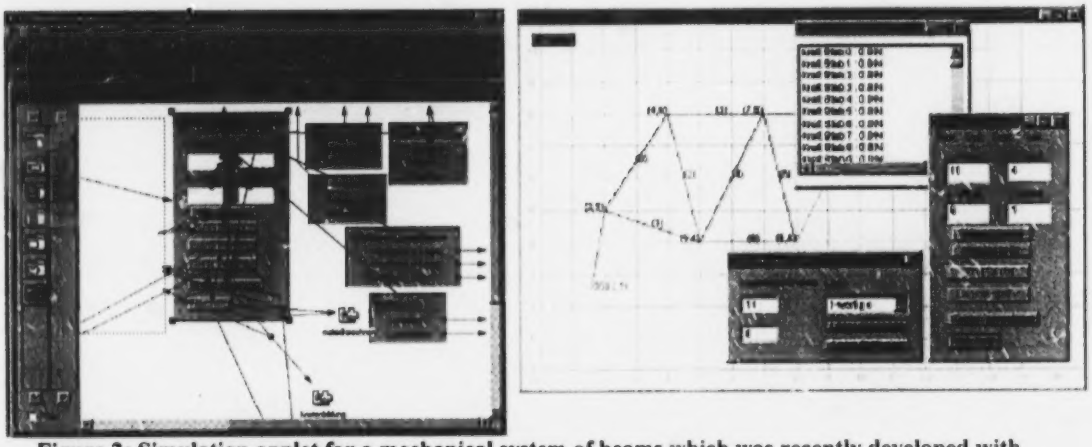

Figure 2: Simulation applet for a mechanical system of beams which was recently developed with IBMs Visual Age Java development environment by one of our students (visual programming of the user interface).

Tools, such as VisualAge from IBM, which offer a programming-from-parts option point into the right direction (Figure 2). However, there is room for improvement. As an example: One of our mechanics students who was not extremely familiar with programming needed about one month and extensive help of a computer scientist to produce a prototype of a small simulation system for the computation of the forces acting within an arbitrarily arranged system of beams (Figure 2). One of our tasks ahead will be the development of extensive class libraries for the visualization of mechanical of concepts and problems that arise in technical mechanics.
Our experience shows that the gain involved with such visual Java development environments results mostly in a swift construction of the user interface of an application. The design of application semantics is not supported in the same degree. On the other hand, students still have problems to understand the various elaborate Java concepts, e.g., the rather complex Java Foundation Classes.

Learning in a learner-friendly environment

The problem of conventional learning, as with the help of black boards, flip charts and overhead slides, is the non-integrated use of these media. A student who attends a lecture together with many other students, e.g., twice a week, is unable to transfer the presented materials to tutorials or even to access literature referenced in the courses at home. Consequently, no continuous access to necessary educational material is guaranteed. A student who does his / her homework must get the same materials as in group working in the university or at the lectures. In the classic form of learning, this continuity was realized in a primitive form by the use of pen and paper. Students prepare lessons by reading and browsing through books and papers and make annotations on copies or write their own summaries. In tutorials and lectures they have to write down what is written on the board and they have to compare their notes with reference books and papers. In the time of collaborative learning it becomes more and more difficult for the students to lively participate in discussion groups and, simultaneously, to write down necessary facts for the following exams. Additional successful and effective forms of learning need student-centered structures of teaching. Student-centered forms of learning are defined as presenting different

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views on the subject to allow students to develop a personal and more sophisticated way of understanding. This may be achieved by the use of electronic media, called multimedia and hypermedia, with the help of new educational didactic concepts and infrastructure requirements.

Therefore, modern electronic learning environments offer possibilities to enhance a student-centered approach for learning. In this concept the student himself is responsible for his/her personal learning progress. Socially embedded learning processes are the necessary precondition for effectiveness of teaching. To achieve better success in the understanding of the presented material, and in order to let students develop their own insights into the topics, it is necessary to offer a wide range of high quality information. The student has to extract the very essence of the many facts provided and, in addition, learn to see the bigger picture, i.e., the connections between the various facts. In conventional forms of learning the students get the information (portions of the presented subjects) step by step and is required to produce his / her knowledge and to show his / her understanding during the examination. The students do not feel responsible for the selection of necessary information. Modern forms of learning require the willingness to accept responsibility for the selection and filtering of fundamental knowledge. The process of extracting the real essence may be defined as the real achievement of learning. The goal of the *mechANIma* project is to reduce the reliability and portability in the use of electronic media, and to create an interactive learning environment that can actively be used by the students.

Such an integrated approach cannot be accomplished by a single research group that creates a high-tech learning island within the of the university. The term "Alltagspraxis" (every day practice) [BrKeil95] has been used to illustrate the objective to set up an infrastructure for suggestive learning and teaching that can be used under the typical constraints of normal day-to-day teaching at a university.

Conclusions

We have described and illustrated the underlying philosophy and integration of animation tools and hypermedia course material into the *mechANIma* hypermedia system. Our key concepts are to increase the reliability and portability in the use of electronic media, the setting up of an infrastructure for suggestive learning and teaching, the achievement of collaborative structures through and with the development of hypermedia materials, and the use of visual programming environments for the programming of animation and simulation systems. We expressed our positive experiences with our students who use Visual Basic as one of the very popular visual to programming environments.

We try to develop new methods and didactic concepts of teaching mechanics in many different courses to students at the university of Paderborn ([BreKeil97], [Keil97], [Keil90]), [HaFeMu98]. Especially the evaluation of new teaching environments and didactic arrangements for the daily use of new media in lectures, tutorials and student assignments is an important part of our research work. One goal of the *mechANIma* project is the achievement of a continuous flow of information between the students and the lecturers.

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DEVELOPING an IMS COMPLIANT DATABASE for WebCT

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Abstract: This paper discusses about adding meta-data tags to courses created using WebCT, an online course authoring material. The reason to add meta-data is to facilitate the searching of learning materials over the World Wide Web. A database is going to be created to save the information about the courses and serve as a repository for the learning sources. The database will be replicated to several sites. The replication feature will be added so in case of site failure there will a backup site and also it will reduce network traffic.

Introduction

The growth of Internet and World Wide Web (WWW) has a huge impact on learning at all levels of education. But there is no standard approach of managing online course materials, locating and using educational content. To mitigate these obstacles the Instructional Management Systems (IMS) Project was created to facilitate the growth and viability of distributed learning in the Internet. IMS is working towards providing a common framework for generating and leveraging information integral to the process of learning[IMS]. To provide a purposeful and effective searching of online resources, IMS is developing specifications for Meta-data. Meta-data, which is "data about data", will add labels to the educational materials. Examples of mata-data for learning materials are the title, the author, educational objectives, targeted learning level, publication date etc. People who are searching for learning resources will use the common meta-data fields to describe the type of resource they desire, use additional fields to evaluate whether the resource matches their needs, and follow up on the contact or location information to access the resource. Similarly, people who wish to provide learning resources will label their materials and/or services with meta-data in order to make these resources more readily available to interested users.

WebCT

World Wide Web Course Tool (WebCT) is a web based educational tool that facilitates the creation of internet based education materials[WebCT].WebCT uses a World Wide Web (WWW)-based graphical user interface (GUI) as a course building environment and provides course enhancing tools like quiz creation, on-line chat, forums etc. The course author connects to a WebCT site using any browser such as Netscape. Usually the server is maintained centrally at the educational institutions. WebCT uses a flat ASCII file format to store data about courses. Each course has a directory on the server into which is put all of the HTML, text, image or audio files created by, or downloaded by the course author. For example, if the course-author defines a set of multiple-choice questions that are to be associated with quiz, files are created by WebCT containing these questions. The file is named by WebCT to indicate its relationship with that quiz. WebCT does not add meta-data to the courses according to the IMS specifications. Also it is not possible for an instructor to locate resources of similar kind. For example, an instructor is offering a course on calculus. If the instructor wanted to create a quiz for the students, he could make a query on the questions so far created on calculus by other instructors. These questions would give him an idea and he can use these resources. Also he could add his own resources so that others could use later.

Scope of Work

University of Central Florida has an agreement with the creators of WebCT that we will work together to add more features to WebCT. One of the proposal is that to add a IMS meta-data fields to the courses offered through WebCT. Also we want to save course information, such as title, creator, subject, questions etc. in a database so that any instructor will be able to query the database for resources.

Implementation

I have used Oracle Enterprise Edition 8.0.4 for Windows NT 4.0 to design the database. I found that WebCT allows an instructor to create five type of questions to add in a quiz. They are: Multiple Choice Questions (MC), Matching Answer Questions (M), Calculated Questions (C), Short Answer Questions(S), and Paragraph Questions. The prototype only considers first four type of questions. Each course can contain several quizzes consisting of combination of the type of questions described before. I created the following tables:

Table Name	Important attributes	Constraints
Questions(information related to a question)	ID, Title, Text, Type	Primary Key: ID
Meta-data(IMS meta-data added to a course)	Subject, Description, Title, Creator, course_id	Primary Key: course_id
MC, MATCH, CAL, SHORT (required to save answer information for each type of question)	Ans_text, Question_ID	All these tables references to the Questions table using Question_ID
Course_link_question (information about course and related questions)	Course_id, question_id	Course_id references to Meta-data table Question_id references to Questions table

An instructor will be able to search the database based on course number, creator, publication date, question type etc. **This database will be local to the user. Duplicate copy of the database will be kept on remote servers. These databases will be linked through TCP/IP. Whenever new information is added to one database, all the tables in remote databases will be replicated at certain interval(for example every night). As a result the instructors will be always be able to get updated information and will not be required to connect to remote servers.** The whole system is shown in figure 1.

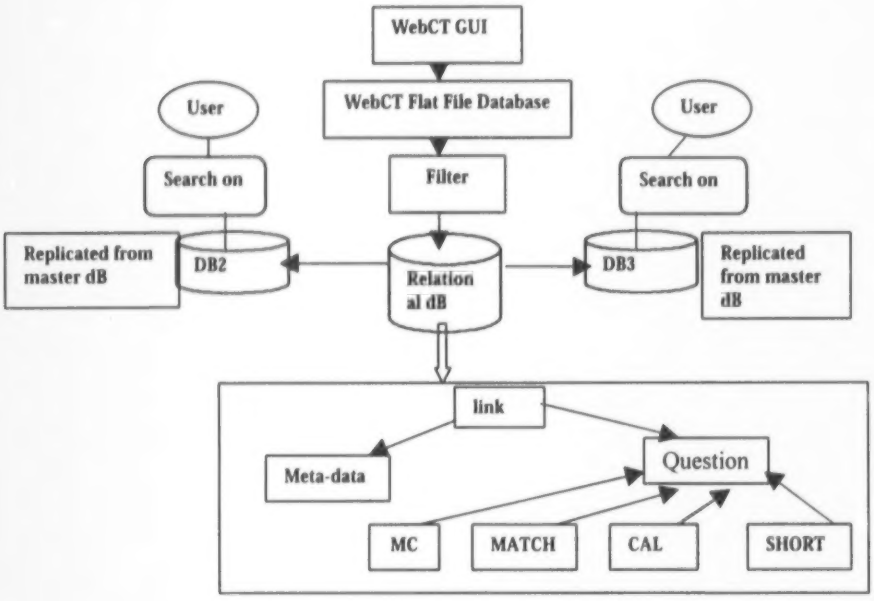

Figure 1: The overall system diagram

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[IMS] http://www.imsproject.org
[WebCT] http://homebrew1.cs.ubc.ca/webct/

Costs of Developing and Delivering a Web-based Instruction Course

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Abstract: *The Internet: Communicating, Accessing & Providing Information* is a University of Alberta credit course which is delivered completely over the Internet. This paper: 1) discusses the primary development and delivery phases of this course, while also providing a general account of the time spent on each of the phases, 2) compares the costs of this course with those of similar face-to-face courses, and 3) offers an interpretation of these results and the possible implications for similar courses.

History of the Course

The Internet: Communicating, Accessing & Providing Information (http://www.quasar.ualberta.ca/nethowto) (henceforth referred to as "the course") has been offered since 1995. The purpose of this course is to help students understand what the Internet is (and isn't), and learn to use Internet tools. This course prepares students to operate effectively in our knowledge-based society, to learn to use electronic communications, to access electronic resources, to prepare electronic resources for the Internet, and to understand and examine critical issues related to electronic communications (Privacy, Security, Copyright, Censorship, and others). The course was delivered for the first time in a face-to-face (F2F) mode September-December 1995. A number of Web pages were developed to support this delivery. The course was offered a second time January - April 1996, again in a F2F mode. During this session, students were asked to provide information on what would make the course more amenable for use by distanced students; this input resulted in a constant revision of the Web pages.

During the second offering of the course, a few students who, for a number of reasons, could not attend the lectures were encouraged to take the course and to rely on the Web pages for their information. They were asked to communicate with the instructors by telephone or electronic mail if they had questions. During May-August, 1996 the course was pilot tested completely over the Internet to over 100 students. Over 500 students have completed the course since it has been offered through Web-based Instruction. A complete discussion of the structure of the course can be found in [Montgomerie & Harapnuik 1997].

Development

The course was developed over a period of slightly more than one year. Four different phases of development occurred, with three different people involved in this development: a graduate student and the first two authors. [Tab. 1] presents the time spent (costs[1]) in developing this course. Times for the F2F delivery are not included in [Tab. 1] but times for delivering the pilot test of the course during the May - August 1996 period are included. The first time this course was offered via web-based instruction (WBI) (and probably the first time any WBI course is offered) can more properly be considered as development time rather than operation and delivery time because real students encounter problems and request clarification that the course authors did not anticipate.

[1] Throughout this paper we present the time spent on a task and call these "costs." Conversion of these times to dollars (or yen) using arbitrary values would obfuscate, rather than clarify the issues.

Task	Hours
Development of course outline and identification of course resources (May – July, 1995)	200
Original Web page design and major revision of course resources (August – December, 1995)	400
Course revision during F2F delivery (January - April, 1996)	60
Course revision prior to first asynchronous delivery (April – May, 1996)	30
Course revision and delivery during first asynchronous delivery (June – September, 1996)	750
Total	**1440**

Table 1: Times for Course Development and Pilot Testing

Following the initial delivery, the course has undergone major updates prior to each session. Because this course is about the Internet the subject matter is constantly changing; thus the course materials need to be updated on an ongoing basis, even during course delivery. Similarly, we needed to use the latest features on the Internet to model appropriate use of the best technology and instructional methods (i.e. "walk the talk"). Taken together, these two situations mean that this course has required a higher level of upgrading than most other WBI courses. The dynamic nature of the Internet demands that content, links, and entire technologies must be continually upgraded. Ironically, perpetual change has been one of the unchanged aspects of this course and we do not expect to see a decline in the rate of change for some time to come.

Course Operation and Delivery

The course has now been offered via asynchronous delivery mode for seven complete sessions. [Tab. 2] shows the time spent on operation and delivery of the course once it had reached "steady state," that is once major development and pilot testing was complete. As indicated previously, the times for the pilot test (May - August 1996) are included in [Tab. 1] rather than [Tab. 2].

The instructor and the teaching assistant (TA) recorded the time spent on six specific course operation and delivery responsibilities in a daily journal. The course operation and delivery responsibilities included updates (revising links, adding news & announcements, etc.), development (adding material or incorporating changes in technology), interacting with students in the Issues & Help conferences, providing email and phone support, and marking. [Tab. 2] summarizes these results for six steady-state offerings from September 1996 to April 1998.

Session	Fall 96	Win 97	Spr 97	Sum 97	Fall 97	Win 98
# of Students	40	78	49	53	71	89
Tasks	Hours	Hours	Hours	Hours	Hours	Hours
Updates (URLs, News Page, etc.)	28	48	5	23	37	41
Development (New material)	13	26	4	37	21	17
"Issues & Help" conferences	240	181	76	50	58	95
Phone support	15	25	13	36	25	16
E-mail Support	27	141	104	101	159	113
Marking	63	127	123	74	173	155
Total Hours	**386**	**548**	**325**	**321**	**473**	**437**
% of total time spent on upgrading and development	**10.6**	**13.5**	**2.8**	**18.7**	**12.2**	**13.3**
% of time spent on interaction	**73.1**	**63.3**	**59.4**	**58.3**	**51.1**	**51.3**
% of time spent on marking	**16.2**	**23.2**	**37.8**	**23.1**	**36.6**	**35.4**

Table 2: Total Hours Spent on Operation and Delivery of the Course

An average of 415 hours was spent delivering and supporting this course each session. During the Fall and Winter Sessions the course is delivered over a 13-week semester while during the Spring and Summer Sessions the delivery time is approximately 6 weeks.

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The time devoted to the Issues & Help conferences decreased after Winter 1997 as a result of the implementation of a more efficient conferencing system and a course management system [Montgomerie, Harapnuik & Palmer 1997]. These two improvements have streamlined the management aspects of the course. A great deal of development time was spent creating and implementing these systems, but because they were not directly related to the instruction of the course, they do not appear in these tables.

Marking times increased significantly in the Fall and Winter sessions. This may be attributed to the fact that Fall session students were granted extensions until April 1 to complete their work. Similarly, Spring session students were granted extensions to September 1, and Summer Session students were given extensions to December 31. The cumulative effect of these extensions is that more students were handing in assignments than the enrollment for the Fall and Winter sessions would indicate.

Development & Upgrading

The ever-changing nature of the Internet requires that constant updates and upgrades must be made to URLs, course content, and assignments. Change has been the one constant throughout the development and delivery of this course. The updates/upgrades and development tasks are closely related. Most course development and upgrades are a result of technology advancement. One of the most tedious tasks is keeping hundreds of URLs current. The time consuming aspect to keeping the links updated is not in finding the broken links, software is available to do this, but a substantial amount of time can be spent finding the new URL for the moved site, or finding (or developing) a replacement for a site that has completely vanished or has become outdated.

Since there is no F2F instruction in this course, students are kept apprised of new information and announcements via an "Announcement" page. Another update is the addition of projects prepared by students enrolled in previous course sections to the course resources database. Other upgrades or course modifications are the result of student suggestions received through email, phone, or the conferencing system. Our policy is that when a student submits an email message directly to the instructor asking for clarification on a particular section of the course, that section is immediately examined and, if necessary, changes or clarifications are made immediately. When a student posts a question to the Help conference, we wait for 24 hours to respond or to make changes or clarifications to the course. Twenty percent of a student's mark is allocated to his/her participation in the Help and Issues conferences; hence it would be inappropriate for the instructor or teaching assistant to respond immediately. Implementing rapid change can be time consuming, but it dramatically improves the content and structure of the course. In addition, students gain a sense of significance or community by seeing that their feedback has immediate results.

In addition to upgrades, time is spent integrating new technology into the course. New technologies like CU-SeeMe™, CoolTalk™, NetMeeting™, HTML editing tools, new browsers, and anything else that is new on the Internet must be tested to see if it can and should be included in the course. For example the Fall 1996 and Winter 1997 sessions saw the integration of CU-SeeMe™[2].

More time was spent in upgrading and development during Winter and Summer sessions [Tab. 2]. The increase in time spent on development and upgrading in the Winter session is in preparation for the upcoming Spring and Summer session. Similarly the increased time spent on upgrading and development in the Summer session is in preparation for the upcoming Fall and Winter sessions.

Support and Interaction

Direct student support includes instructor and teaching assistant time spent working on the Issues & Help conferences and phone and email support. These three components of a web-based course are crucial to the course's successful delivery and to the students' learning experience. In addition, each plays a major role in offering students who do not have the opportunity to meet F2F an opportunity to interact with the instructor. A variety of support opportunities must be presented because different students have different learning styles that

[2] CU-SeeMe is a trademark of White Pine Software, CoolTalk is a trademark of InSoft Inc., and NetMeeting is a trademark of Microsoft.

often require a different level of interaction. Some students insist on using the telephone to make a more personal contact. Other students are satisfied with the conferencing system and others seek a middle ground by using email.

The instructors and teaching assistants spent more than half the course delivery time in some form of interaction. [Tab. 2] shows a significant decrease in time spent responding to questions on the Issues & Help conferences after the Winter 1997 session. This difference was the result of the implementation of a much superior conferencing system for Spring 1997. With the conferencing component playing such a substantial role in replacing F2F interaction it is imperative that the most effective, efficient and economical conferencing system be employed.

It can be argued that the current levels of interaction are higher than in a traditional F2F setting. Participation in the Help and Issues conferences is required of all students and makes up 20% of the final course mark. Because of this, total class interaction is very high, and virtually all students participate. Some students keep their interactions to a minimum and others go well beyond the required interaction levels on the conferences. Many students acknowledge that the conference system offers a level playing field and makes interaction much more comfortable. A major portion of the time spent on the course for both students and the instructors is spent in some form or interactive communication.

Different sessions have had different levels of interaction. For example, Spring session of 1997 saw an average of 47.9 interactions per student [Tab. 3]. More than 50% of those interactions were in the form of email communication directly with the course instructor or TA. On average there have been over 38 interactions per student. It must be stressed that more than 50% of these interactions were between the student and instructor. This is a high level of interaction for any type of course.

Session	Fall 96	Win 97	Spr.97	Sum.97	Fall 97	Win 98
# of Students	40	78	49	53	71	89
"Issues & Help" conferences	n/a	n/a	1077	1064	1277	2892
E-mail Support	319	1299	1173	926	1035	1256
Total	319	1299	2250	1990	2312	4148
Average interactions per student	*IN	*IN	45.9	37.5	32.6	46.6

*IN: Incomplete statistic. We were not able to extract an accurate message count from the conferencing system used in Fall 1996 and Winter 1997.

Table 3: Number of Interactions between Students and Instructors/Teaching Assistants

Marking

Evaluating student work is always an important part of any course. Depending on the content and assignments, marking can either be very time consuming or it can involve very little time and even be automated. The androgogical foundation to this course is that people learn by doing. All assignments deal with actual skills needed to function on the Internet. The course has no exams and except for two small assignments the student evaluation is project based. Students are required to build an HTML portfolio, worth 25% of their final grade, which demonstrates their Internet skills. They are also required to do a final project, the development of a Web site on the topic of their choice, which is worth 50% of their final mark. Grading these projects can be very time consuming, however. To assure objective marking, a template has been developed, which gives students detailed feedback on the two major projects in the course. A major portion of the marking time deals with the writing of these detailed evaluations.

The proportionally higher marking times in the Winter and Fall sessions [Tab. 2] can be attributed to the higher number of students working on extensions in these two sessions than the number of students working on extensions in the Spring and Summer sessions.

A Cost Comparison with F2F Courses

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[Tab. 4] shows the number of hours the Instructors and TAs spent in each area of the course for the six "steady state" sessions and [Tab. 5] summarizes that data. An examination of [Tab. 4] shows that the time spent monitoring the electronic conferences was inordinately high for the first two sessions. Replacement of the conferencing system following the Winter 1997 session reduced this time by approximately half. Corrected times, which reduce this time by half for the first two sessions are included in [Tab. 5].

		E-mail		Conference		Telephone		Marking		Develop-ment	Updating
	# of students	Instructor	TA	Instructor	TA	Instructor	TA	Instructor	TA	Instructor	Instructor
Fall 96	40	27		240		15		63		13	28
Win 97	78	65	33	182	7	0	1	46	101	26	48
Spr 97	49	46	59	78	27	2	11	32	91	4	5
Sum 97	53	50	50	50	10	20	16	26	49	37	23
Fall 97	71	81	78	58	4	13	11	26	148	21	37
Win 98	89	45	68	94	0	15	2	17	138	17	41

Table 4: Time (in hours) Spent on Course by Instructors/Teaching Assistants

Session	Number of students	Instructor Hours	TA Hours	Instructor Hours (corrected)	TA Hours (corrected)
Fall 96	40	386		266.0	
Winter 97	78	367	142	276.0	91.5
Spring 97	49	167	188	167.0	188.0
Summer 97	53	206	125	206.0	125.0
Fall 97	71	236	241	236.0	241.0
Winter 97	89	229	208	229.0	208.0
Linear Regression	Intercept	281.4	117.1	192.7	137.2
	Slope	-0.257	0.937	0.6	0.5

Table 5: Summary of Time Spent on Course by Instructors/Teaching Assistants

[Fig. 1] displays a graph of the number of hours that the Instructors and the Teaching Assistants worked on the course by the number of students enrolled in each session. The corrected times (reducing the time spent monitoring the conferences for the first two sessions by half) are also plotted. A linear regression has been plotted for each series. The intercept and slope for each regression line are given in [Tab. 5]. As can be seen, the intercept for the corrected values for the instructor is 192.7 (that is, if there were no students enrolled in the course, the instructor would spend approximately 193 hours on the course). The slope of the line for the corrected values for the instructor is 0.221 (that is, each student adds a load of approximately 0.22 hours to the instructor). The intercept for the corrected values for the TA teaching assistant is 120.9 (that is, if there were no students enrolled in the course, the teaching assistant would spend approximately 121 hours on the course). The slope of the line for the corrected values for the teaching assistant is 0.106 (that is, each student adds a load of approximately 0.10 hours to the teaching assistant).

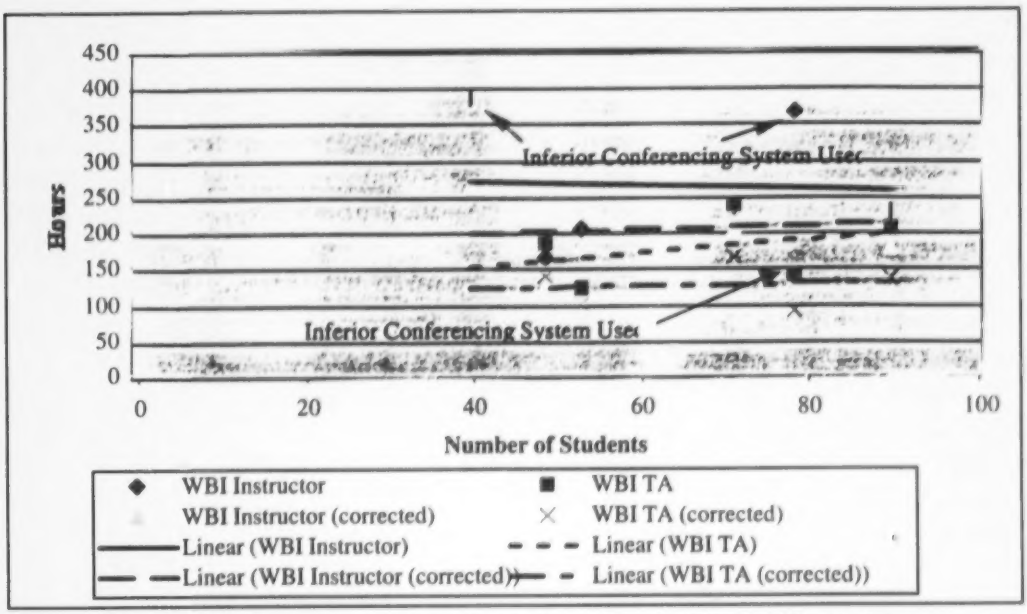

Figure 1: Time Spent on the Course by the Instructor and the Teaching Assistant

At the University of Alberta, where we teach, each course is allocated approximately 35 hours of lecture time. If we assume that for each hour in the classroom a professor spends another hour in preparation or marking (likely a low estimate); an average course would require approximately 70 hours of instructor time. Normally graduate courses are limited to 20 students (this was originally designed as a graduate course but due to a strong demand, senior undergraduate and unclassified students have been allowed to enroll in the course). Furthermore this is a laboratory course which would require teaching assistant to monitor a 3-hour lab of about 25 students (the size of our computer labs) each week for 12 weeks (a total of 36 hours).

[Fig. 2] overlays estimated time allotments for F2F Instructors and F2F teaching assistants on the WBI (corrected) regression lines from [Fig. 1]. Note that resources expended on students enrolled in WBI courses can be considered to be incremental, while expenditures on students enrolled in F2F courses should be considered to be a step function due to limitations such as the number of seats available in classrooms and laboratories. We have used a step function of 20 students for the instructor and 25 for the teaching assistant. An examination of [Fig. 2] shows that the WBI instructor spends more time per student up to 40 students at which point the amount of time spent by the F2F instructor becomes greater. Similarly, the WBI TA spends more time per student up to 75 students where the amount of time spent by the F2F TA becomes greater.

Some may dispute the choice of a class size of 20 students. In our course there is a high degree of interaction between the instructor and the students; this would be more similar to a seminar than to a lecture. If someone wished to deliver a WBI course with substantially fewer interactions, it might be comparable to F2F instruction in a 100-seat lecture theatre. If that were the case, then the time spent by the WBI instructor monitoring electronic conferences should be reduced close to zero. In the case of our course, the average number of students enrolled in each session has been 63.3 which means a time savings was incurred by offering the course by WBI rather than in a F2F mode.

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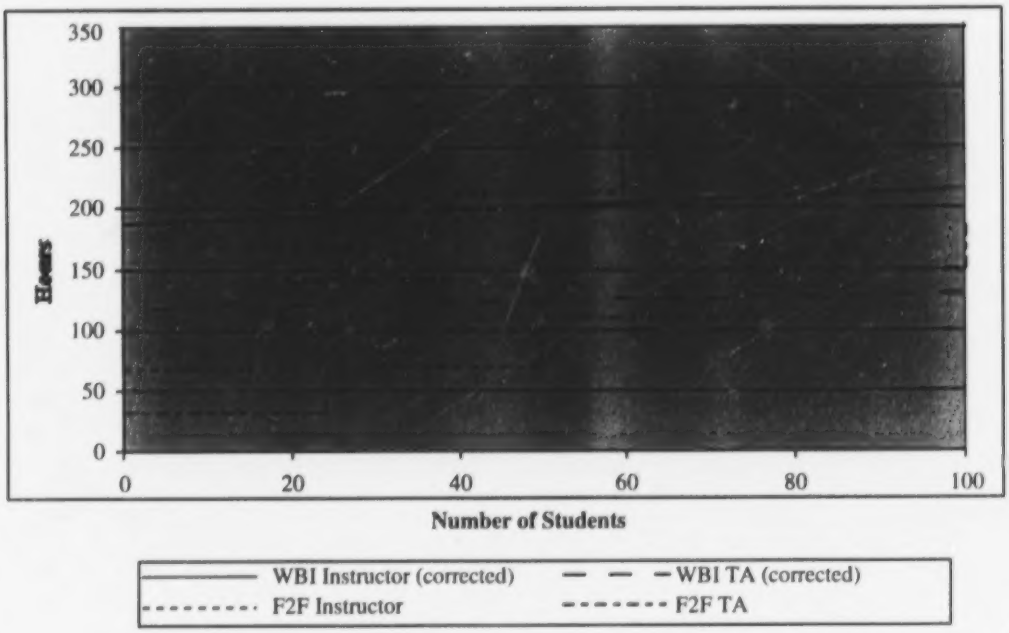

Figure 2: Comparison of Times Delivering WBI with F2F Instruction

When considering these costs, one must remember that the nature of both the content and delivery of this course is likely changing more rapidly than in most other courses. However, the costs for courses taught by WBI which deal with less rapidly changing subject matter are still likely to be higher than for an equivalent F2F course when there are low enrollments. When considering costs, however, one must also consider the level of success that has been achieved. Over 50% of the time spent on the delivery of this course has been spent on some aspect of interaction (email, conferencing, and phone). This high level of interaction is a major contributor to the 90% completion rate that we have experienced since the course has been delivered.

The times discussed so far in this section are for the ongoing delivery of instruction. None of the development time identified in [Tab. 1] has been included. The time spent preparing a new course is substantial for both WBI and F2F instruction, but before the course begins, WBI instructors need to prepare all materials in a form that the student can access on-line. In the case of our course, this preparation was 1440 hours, which is likely substantially more than is required for the development of a new F2F course. This development time should be prorated over some of the "steady state" delivery sessions. Further, Instructors and administrators must recognize the time involved in developing a WBI course and budget time for this development.

Conclusions & Recommendations

When implemented properly, WBI can offer a quality instruction with a much higher degree of interactivity for relatively large classes than may be possible in traditional F2F settings. It is clear from this study that, at least in this specific case, this course took less person hours to deliver than it would have if it were offered in a F2F mode. Of course, if the course had not been offered via WBI, we would have had a much smaller enrollment because the students in Singapore, Freiburg, Pender Island and Teepee Creek would not have been able to take the course.

Students took advantage of e-mail and conferencing systems to communicate directly with the instructors. Some would suggest that we could ask TAs to assume a considerable portion of this workload, but we would argue that it is important that students have this access to the instructor. Further, the offering of this course through WBI rather than F2F meant that University facilities like classrooms, washrooms and those very expensive computer laboratories were not used by these students.

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On the other hand, WBI has substantial costs. The development of a new WBI course requires the allocation of substantial time. The high degree of instructor/student interaction in this course puts substantial strain on the instructor; there are no office hours, but the instructor must read and respond to e-mail, phone and conference messages at least once a day. Further, courses with a low enrollment will cost more to deliver via WBI than would an equivalent F2F course.

University administrations need to look seriously at the economics of implementing WBI. If instructors are given the time that is actually required to work using this form of delivering education, then it can be a very educationally effective and cost-effective method of instruction. However, if instructors are expected to develop, maintain, and support this type instruction with the same time expectations of F2F delivery, the quality of education will be in jeopardy and instructors will run the risk of burnout.

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Inquisitivism or "The HHHMMM??? What Does This Button Do?" Approach to Learning

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Abstract: Inquisitivism or "The HHHMMM??? What Does This Button Do?" approach to learning is a synthesis of cognitive theories that provide a novel approach to technology related adult learning. It gives learners the freedom and opportunity to control, construct and take responsibility for their learning experience rather then force learners into following a strict and often confusing set of procedures or instructions. Learners using this approach quickly gain confidence and overcome the debilitating fear that often accompanies technology-related learning.

What I mean to discuss in this paper is the need for a new approach to adult learning. That is to say, I wish to discuss the development of a learning approach based on the unique needs of adult learners who are required to learn and use new information technologies. More specifically, I will establish how a learning approach I have labeled Inquisitivism has evolved from a synthesis of key cognitive learning theories into one cohesive approach and how its implementation in the development of learning environments, curriculum and courses, can meet the needs of today's adult learner.

To successfully fulfill the task that I have I laid out I will: 1) Explain why there is a need for a new approach to adult learning. 2) Identify contemporary cognitive learning theories that this new approach will be based upon. 3) Finally, establish the learning approach of Inquisitivism. A practical application of the Inquisitivism in Web-Based Instruction (WBI) will be the basis of discussion of a subsequent paper.

The Need

A central theme of many papers presented at recent educational conferences and published in educational journals is that many of our instructional systems are failing or are in need of repair. In addition, many articles call for a complete change in the way we design and deliver educational material. *Objectivism vs. Constructivism: Do we need a new paradigm?* (Jonassen, 1991), *Web-based distance learning and teaching: Revolutionary invention or reaction to necessity* (Rominiszowki, 1997), and *The Learning Revolution* (Dryden & Vos, 1994) are only three of the many articles or books that call for a significant change in learning models. Some argue that there is a common basis for many of the current problems in education discussed in these and similar books. There are claims that the deficiencies in the outcomes of learning are strongly influenced by underlying biases and assumptions in the design of instruction (Rand J. et al., 1991). The systems approach to instructional design which has no substantive theory content, no user domain content and is arguably the primary factor contributing to the poor outcomes of instruction, is still the predominant instructional design assumption used throughout most of education (Carroll, 1990; Dryden & Vos, 1994; Jonassen, 1997; vad der Meij & Carroll 1995).

Another theme revealed in recent work calling for change deals with the limitations of instructionism. This dominant method used in most instructional settings is based on the notion that students are passive receptacles for information that the instructor (teacher or instructional media) relays (Jonassen, 1996). Carroll (1990) titled his polemic against the systematic approach to learning and instructionism, the *Nurnberg Funnel.* The legendary Funnel of Nurnberg was said to make people wise very quickly by simply pouring knowledge into them. In the *Nurnberg Funnel,* Carroll presents the results of ten years of empirical research that shows that newer methods of instruction based on Constructivism and other cognitive theories perform much better than the commonly used systems approach to instruction. This literature points out that there is a need for a substantial change in the way instruction is developed and delivered.

Cognitive Learning Theories

It can be argued that cognitive theory is a reaction against behaviorism. By going beyond the information given and focusing on the mental processes that are involved in knowing and learning, cognitive theories offer a much larger view of human capability and potential (Bruner, 1973). In general, cognitive theories place an emphasis on higher order thinking and look at the processes that are involved in all aspects of knowing and learning. Constructivism is perhaps the most well known cognitive theory and represents much of the current emphasis of the cognitive movement (Di Vesta, 1987). In addition to constructivism, the following theories discussed will form the basis of the Inquisitive approach.

Constructivism

Constructivists posit that learning is an active process in which individuals construct knowledge based on their interactions with the world. Learners rely on their cognitive structures, their needs, beliefs and prior knowledge to transform new information into new knowledge. It could be argued that Constructivism is a theory of knowing as opposed to a theory of learning.

Bruner (1966) states that a theory of instruction should address four major aspects: (1) predisposition towards learning, (2) the ways in which a body of knowledge can be structured so that it can be most readily grasped by the learner, (3) the most effective sequences in which to present material, and (4) the nature and pacing of rewards and punishments. Instruction should be concerned with the experiences and contexts that make the student willing and able to learn, structured so that it can be easily grasped and designed to go beyond the information given (Kearsley, 1997).

Social constructivism focuses on socially co-constructed knowledge that is based upon a groups interaction with the world. Vygotsky's social learning theory is often used as an example of social constructivism.

The theory of andragogy is specifically for adult learning. Knowles (1975, 1984) posits that adults are self-directed and expect to take responsibility for decisions. Therefore, adults can be expected to take responsibility for their own learning. Instruction for adults needs to focus more on the process and less on the content being taught. The designer of adult learning must keep in mind that: adults need a valid reason to learn something, they learn experientially, they often approach learning as problem-solving, and they learn best when the subject they learn can be immediately applied. In addition, instructors should act as facilitators and allow learners to discover things for themselves, but still provide guidance and help when mistakes are made.

Discovery Learning

Discovery learning refers to obtaining knowledge for oneself (Bruner, 1961). This does not mean that students are allowed to do as they wish. Rather, students are directed by the instructor to either solve a problem or gather information and develop a hypothesis. Meaningful learning is promoted by discovery because the learner uses inductive reasoning to formulate general rules, concepts and principles. Discovery learning is especially useful and beneficial in the training and instruction of teachers. The discovery learning process requires a learner to focus more on the process than the content. This emphasis on process allows prospective teachers to better understand the dynamics of learning helping them to become more effective instructors.

Activity Theory (Active Learning)

Activity Theory is based on the notion that human learning is mediated through practical activity and activity is mediated by cultural signs: language, tools, media, and conventions. As the products of learning change, activity changes along with the consciousness of the participants in a continuous, evolving cycle of learning. Activity is fundamental to learning. Proponents of activity theory would argue that it precedes knowledge and there is no understanding apart from it.

Functional Context

Making learning relevant to the experience of the learner is the key to the functional context approach. New information is related to existing knowledge (information in long term memory) and transformed into new

knowledge. This transformation is facilitated by cognitive processing skills including language, problem-solving, and learning strategies. Instruction that utilizes this approach strives to use the same materials in the training that will be used in the "real world".

The functional context approach was developed specifically for adult technical and literacy training (reading/writing/mathematics) in military programs, but it has implications for learning of basic skills in general (Sticht, 1976) and reading in particular (Sticht, 1975). Functional context theory shares a similar emphasis with Situated Learning theory which also stresses the importance of context during learning (Kearsley, 1997).

Minimalism

Minimalism should be referred to as a descriptive approach to designing effective instruction. "One of the key ideas in the minimalist approach is to present the smallest possible obstacles to learners' efforts, to accommodate, even exploit, the learning strategies that cause problems for learners using systematic instructional materials." (Carroll, 1990) The minimalist goal is to get out of the way of the learner and let them get more out of their training (learning) experience by providing a less overt training structure.

Unlike many of the other learning theories and approaches minimalism has been developed from the empirical process. Carroll's research at the IBM Watson Research Center in the 1980's revealed that traditional systematic instructional materials were very ineffective and often hindered the learning of new technologies by trapping the learner in error loops within the instructional material. Learners often experienced more problems working through the support and learning material than they did by simply attempting to learn the new system through discovery exploration (Carroll, 1990).

In the first of many experiments Carroll and his associates reduced 94 pages of the systematic training manual of the IBM DisplayWrite to 25 cards. The cards did not include any step by step procedures, but provided general information for completing a task. The cards were intentionally created incomplete so that learners would focus on the task at hand and fill in the missing details which ultimately facilitated the construction of their own understanding. The learners were encouraged to work directly on the DisplayWrite system and use the cards for direction or guidance.

Out of a group of twelve participants, six used the guided exploration (GE) cards and the other six were given the traditional systems-style manual (SM). Both groups were expected to complete their respective training by working through either the drill or practice of the systems-style manual or the twenty five GE cards. Both groups were evaluated by being required to complete a real task of transcribing a one-page letter into the word processor and printing it out. The participants were asked to think out loud and their thoughts were recorded by research associates. In addition, the session were video taped so that all the data could be collated and taxonomized to develop a qualitative picture of how GE learning was contrasted by SM learning.

The guided exploration cards allowed for much faster initial learning and more successful performance in the achievement task. The learning time for the GE participants was less than half of what it was for their SM counterparts; 3 hours and 55 minutes vs. 8 hours and 5 minutes (Carroll, 1990). Similarly, GE participants spent half the time on the achievement task as did their SM counterparts and the GE group achieved much greater success than the SM group. The GE group spent more time working on the actual system trying out more operations than the SM group who spent most of their time reading about the system. Not only did the GE group work effectively with the operations they need to complete their task, they experimented with many more aspects of the system.

The GE group had much more success because they worked with the system itself and took responsibility for their own learning. They demonstrated much more initiative and used errors as learning experiences. In contrast, the SM group often became trapped in error loops created by the systems-style manual. The problems the SM group experienced with the instructional material hindered, or in some cases, prevented the learner from working with the system they were attempting to learn.

Additional experiments were conducted over a 10-year period that demonstrated the minimalist approach to be much more effective than the traditional system approach in virtually all aspects of technical training involving adults. It is from this body of research that Carroll has developed the rubric of minimalist instruction. The nine concepts listed below make up the primary principles of Carroll (1990) minimalist approach:

1. **Training on real tasks.** This is one of the key differences from the systems approach. All training must take place on the actual system that is being learned.
2. **Getting started fast.** Adult learners often have other interest than learning a new system. The learning they undertake is normally done to complement their existing work. The "welcome to the system" prefaces and other non-essential layers in an introduction are simply a waste of the learners' time.
3. **Reasoning and Improvising.** There is no single correct training method or procedure. Allowing for self

directed reasoning and improvising throughout the learning experience requires that there is a substantial reduction in the verbiage and volume of learning materials.

4. **Reading in any order.** Materials designed to be read in any order cannot be read in the wrong order. This will eliminate the common problems that arise from material read out of sequence.
5. **Coordinating System and Training.** The most effective way to coordinate the system and training is to conduct the training on the actual system being learned.
6. **Supporting Error Recognition and Recovery.** Much of what learner does is "error". Since there is such a pervasiveness of errors in most learning, it is unrealistic to imagine that errors can be ignored. Error recognition and recovery strategies need to be implemented to enable learners to learn from their mistakes instead of being trapped by them.
7. **Exploiting Prior Knowledge.** Most adult learners of technology are experts in other areas or domains. Understanding the learners' prior knowledge and motivation and finding ways to exploit it is one of the keys to effective adult training.
8. **Using the Situation.** The learning situation itself can provide many details. In many traditional cultures, "teaching" never occurs. Children are not shown how to perform skills or rituals or understand myths, but are shown in context how to participate (Brunner, 1996a: 151)
9. **Developing Optimal Training Designs.** Instructional models are not deductive or prescriptive theories; they are descriptive processes. There is no "deductive theory of minimalist instruction" that given a set of minimalist principles, will allow us to crank out a minimalist training manual (Carroll, 1990: 91). In contrast the design process should involve the actual learner through empirical analysis so that adjustment can be made to suit the learners needs. "Develop the best pedagogy that you can. See how well you can do. Then analyze the nature of what you did that worked." (Brunner, 1960)

A secondary key to the minimalist approach is the need to discover and support the learners sense-making efforts. This discovery is a dynamic approach that will not only involve the instructional designer, but also the learner. There is no minimalist checklist that a designer can use to create effective instruction. Carroll (1990) states that taking checklists seriously is perhaps the most typical and debilitating design fallacy.

The minimalist approach to learning offers one of the best theoretical foundations from which adult instruction can be designed. Like many other approaches, minimalism is a synthesis of many other theories that propagate the educational psychology landscaped. Despite offering many sound concepts for instructional design, the minimalist approach lacks a number of key components that are required for today's adult learner.

Inquisitivism

While Constructivism and many other cognitive theories and approaches examined in this investigation do stress that learner must be motivated, or at least have a predisposition towards learning, most do nothing more than state a variation of this fact. Experience in the past five years of instructing a variety of technology related courses face2face or online, has revealed that you can have an adult learner who is motivated to learn or,at minimum, predisposed to learning, and yet these same people have difficulty with the simplest of tasks and procedures. They want to learn; they paid their fee for their course, have shown up for the class or accessed the information online, yet they seem to be paralyzed. Why?

Fear! Fear of wrecking the computer; fear of breaking the system; fear of loosing their data and a whole host of related or even unrelated fears. Helping adult learners overcome their fear of technology is one of the first steps in creating a successful learning environment. Convincing an adult learner that there is nothing to be afraid of can be achieved through either explaining or demonstrating that the system cannot be broken or wrecked. In addition, it is just as important to demonstrate that mistakes will happen, the system will eventually crash, but it can be restarted. Finally, implemented effective backup procedures at the system level can help reduce or eliminate the fear of loosing data. Letting the learner know that working with technology can, and will, at times be frustrating will help reduce the amount of paralysis that can occur when things go wrong.

Dispelling the learners' fear is only one part of the challenge in adult education. The second and often more difficult related challenge is stimulating the natural curiosity or inquisitiveness that decades of traditional formal education have so successfully squelched. There have been numerous studies conducted over the many years that clearly demonstrate the first six to ten years of a child's life (the actual period depends on the study) are the most critical period of development.

A young child is a natural scientist. This can be easily demonstrated by giving an infant a piece of paper or a toddler a stick. The toddler's natural inquisitiveness will motivate him to see what kind of an instrument the stick will make by shaking it or hitting it against another object. Next the child could check out engineering, mechanical

or tensile strength of the stick by seeing if they can break it. The economic value of the stick is assessed by offering the stick to another person. By placing the stick in their mouth the child is determining the chemical composition of the item. New parents find out very quickly that anything within reach become objects of investigation. This natural inquisitiveness is what adults need to adopt in order to not only succeed at learning new technologies, but also enjoy the experience.

For the past five years I have been using this example of the child as an investigative scientist to motivate adults to become inquisitive. In addition to the child scientist example, I also ask my new class of adult learners to think of their children; nieces, nephews, or family friends, when it comes to learning computer games. Within minutes of handing a computer program or game to a child they have it installed, clicked on every menu item and button on screen, and are well on their way to racking up a score that most adults could never dream to achieve. Children excel at the computer and other technologies because they follow the "HHHMMM??? What does this button do?" approach to learning. Adults can have almost the same level of success with technological learning if they allow themselves to be inquisitive.

Inquisitivism is a proposed learning theory that is based on a variation of the Constructivist learning theory of Minimalism. Since "inquisitive" is defined by Websters as: 1) given to inquiry or research; eager for knowledge; curious. 2. unduly curious; prying; the label of "Inquisitivism" has been used to describe this approach. Much like Minimalism, Inquisitivism is a synthesis of other learning theories and approaches so many of the key concepts will be adapted from other theories. The key concepts of Inquisitivism include:

1. **Fear removal.** Dealing with the paralyzing fear that many adult learners experience must precede the stimulation of one natural inquisitiveness. Demonstrating that the computer or other piece of technology is not easily broken, providing explanations, examples and solutions for common errors and problems and the application of data backup will help quell the adult learners fear.
2. **Stimulation of inquisitiveness.** With the fear abated, encouraging adult learners to become like children and enjoy the pleasure of inquisitiveness can be easily facilitated. Encourage the use of the "HHHMMM??? What does this button do?" approach.
3. **Using the system to learn the system.** This is one of the key differences from the systems approach. All training must take place on the actual system that is being learned.
4. **Getting started fast.** Adult learners often have other interests than learning a new system. The learning they undertake is normally done to complement their existing work. The "welcome to the system" prefaces and other non-essential layers in an introduction are often a waste of the learners' time.
5. **Discovery Learning.** There is no single correct method or procedure. Allowing for self directed reasoning and improvising through the learning experience will require the adult learner take full responsibility for his/her learning.
6. **Modules can be completed in any order.** Materials must be designed to be read or completed in any order. This will eliminate the common problems that arise from material read or completed out of sequence.
7. **Supporting Error Recognition and Recovery.** Much of what learner does is "error". Since there is such a pervasiveness of errors in most learning it is unrealistic to imagine that errors can be ignored. Error recognition and recovery strategies need to be implemented to enable learners to learn from their mistakes instead of being trapped by them. Use of Frequently asked Question lists (FAQ's), Help Forums and other help strategies must be implemented to deal the errors and problems that arise.
8. **Forum for Discussions and Exploiting Prior Knowledge.** Much adult education dealing with technology is conducted through alternative delivery. Distance education, WBI and other alternative delivery methods can isolate students. Providing a conferencing system for the replacement of F2F interaction is a crucial component of any alternative delivery program. Most adult learners of technology are experts in other areas or domains. Understanding the learner's prior knowledge and motivation and finding ways to exploit it is one of the keys to effective adult training. In addition, adult learners can share their expertise or assist each other and should be encouraged to use conferencing system to facilitate social interaction.
9. **Real World Assignments.** "Make-work" (purposeless) projects are simply useless. All assignments must have a real world application. Adult learners are often undertaking training to be able to work in their own area of expertise more effectively. If possible, the assignments should be tied directly to the learner's personal or professional interests while at the same time challenging the learner to expand their current knowledge base..
10. **Developing Optimal Training Designs.** Feedback facilities like online surveys or email should be used to allow learners to immediately provide feedback on any aspect of a program. Problems with instructions, assignments, wording or other problems should be immediately addressed and corrected. Instructional

models are not deductive or prescriptive theories, they are descriptive processes. The design process should involve the actual learner through empirical analysis so that adjustment can be made to suit the learners needs. "Develop the best pedagogy that you can. See how well you can do. Then analyze the nature of what you did that worked." (Brunner, 1960)

Like the minimalist approach, Inquisitivism is a huge departure from the familiar step by step procedures of the systems approach. Carroll's (1990) research has demonstrated the reason the systems approach is so ineffective is not that people are not capable of following step by step instructions, they just choose not to. Inquisitivism gives students the freedom and opportunity to control and construct their learning experience.

Perhaps it is the familiarity of step by step procedures that motivates people to choose this ineffective method of instruction. Even though guided discovery that has been implemented in the inquisitive approach as well as other learning theories and approaches has been shown to be a more effective way to learn, many students still seek the comfort and solace of traditional systems based tutorials and manuals. We truly are creatures of habit. Like the minimalist approach, inquisitivism has been showed to be successful. The successes and failures of this fresh approach to learning will be the basis of a subsequent discussion.

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Implementing Information Competency Through Web-based Learning Applications in Higher Education: A Case Study in Integrating an Instructional Web Site into the Curriculum

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Abstract: California State University, Fresno is introducing core information competence skills to First-Year Experinece students through its University 1 freshman seminar course. The University 1 web site is a major component in this effort. This panel describes the Information Competence initiative and the initial and subsequent efforts to utilize a web site to address information competence, support service information dissemination, and instructional content delivery.

1. Introduction

Information competence is becoming a key issue for the California State University (CSU) system as it implements sweeping educational technology initiatives designed to infuse technology into all phases of the University. For students this is both an opportunity and a challenge as their learning experience expands to include a variety of information technologies and methods. The ability to access, evaluate, interpret and utilize technology-delivered information is, therefore, critical for today's university student. Information competence then becomes an important factor influencing students' success in completing their college degrees. In the face of these high expectations, educators are concerned about the informational and technological obstacles and negative consequences for students who have limited information competence. At California State University, Fresno efforts are underway to insure student success by integrating information competence, facilitated by a curriculum specific instructional web site, within the University 1 First-Year Experience course.

The panel will discuss the California State University Information Competence initiative and it's implementation at CSU Fresno's through the University 1 First-Year Experience course and its related web site. Panelists will include a case study discussion about the University 1 web site project from its initial implementation through the evaluation and subsequent redesign of the site.

2. Background

2.1 Overview of Information Competence in the California State University

Since 1996, the CSU Commission on Learning Resources and Instructional Technology has supported a system-wide initiative on Information Competence. This is defined as the ability to find, evaluate, use, and

communicate information in all of its various formats. The initiative is guided by a workgroup comprised of librarians, teaching faculty and administrators.

A major effort of the workgroup has been the publication of a document that defines and recommends basic competence levels on "the use of recorded knowledge and information and processes for assessment of student competence" [CSU 1995]. This document, entitled "Information Competence in the CSU: A Report," sets standards and recommends ways of implementing information competence in the curriculum.

A particularly important part of the report is the premise that information competence, like any other competence, is achieved through a systematic process of increasingly sophisticated levels of exposure throughout a student's academic career. Optimally, information competence should be introduced in First-Year Experience or orientation courses, developed in General Education classes, and reinforced in Capstone or interdisciplinary courses.

For the past two years, California State University, Fresno has worked with the Commission to embed this process in the curriculum and to infuse these levels of exposure in a number of course settings [CSU Fresno 1997]. University 1, a 3-unit credit course that focuses on the skills necessary for a successful academic career, is one of those courses.

2.2 Overview of University 1 at California State University, Fresno

First-Year Experience courses are rapidly becoming one of the most sweeping programmatic endeavors in higher education, given impetus by a marked increase in public demand for accountability and educational outcome. National statistics indicate that some 40% of entering college students will leave the higher education system without earning any type of college degree. Of this number, almost half of all students who leave college will drop out during their freshman year, often during the first few months of their first semester. A well-established body of research supports that first-year academic courses promote student retention by providing a foundation for effective learning and information processing.

University 1, a First-Year Experience course, has been offered at CSU, Fresno since Summer, 1996. The course emphasizes student involvement in adaptation to change, critical thinking, writing, information competence, priority and financial management, computer use, interpersonal communication, health and diversity issues, campus resources and career planning. A component of the course also includes more traditional content focused on studying, note-taking and test-taking strategies for success in academic coursework. The course is challenging, multi-dimensional, and develops student skills across many domains.

As a result of the recommendations of the CSU Workgroup on Information Competence, University 1 is addressing the identified core competencies that form the foundation of information competence in the CSU [Fig. 1]. In order to be able to find, evaluate, use, and communicate information, students must be able to demonstrate these skills in an integrated process.

1. State a research question, problem, or issue
2. Determine the information requirements for the research question, problem, or issue
3. Locate and retrieve relevant information
4. Organize information
5. Analyze and evaluate information
6. Synthesize information
7. Communicate using a variety of information technologies
8. Use the technological tools for accessing information
9. Understand the ethical, legal, and socio-political issues surrounding information and information technology
10. Use, evaluate, and treat critically information received from the mass media
11. Appreciate that the skills gained in information competence enable lifelong learning

Figure 1: California State University Workgroup on Information Competence core information competence abilities.

The new University 1 Website was designed to help develop these competencies. It contains online course information, instructional supplements, a student handbook, and a continually evolving set of modules for information competence and interactive student activities.

3. University 1 Web Site Case Study

3.1 The Initial University 1 Web Site

The University 1 web site was initially developed in response to the need to provide students with information, in a manageable form, about the various student support services. During the first semesters of the program, the information was provided through guest lectures presented by staff from the various support services. When the projection for the number of courses reached 40-60 it became apparent that presenting this material in a lecture format for each section would be a tremendous burden on the staff of these services. Various formats (e.g., video) were investigated to provide these materials for the student without much success. It was felt that students would benefit more from an interactive approach while working with the material. This is when the abilities of the internet were first investigated.

The first attempt at designing a web site for the course was based on a metaphor of life enrichment. Students were directed to view the various components which make them a complete person. These included the intellectual, physical, emotional, and social aspects of a person. Students wishing to engage in enriching experiences in any of these areas were able to wander freely down any path to discover activities designed to develop that aspect of the person.

The life enrichment metaphor represented a grandiose and somewhat esoteric approach to the web site that presented an abundance of materials for students to choose from. Students were challenged by the maze of links and confused by the life enrichment metaphor. For many students this made it difficult for them to stay focused on the information goal that was the reason for their visit to the web site. This was especially challenging for the first-year student who lacked internet experience or had not previously utilized the internet for academic pursuits.

After the first semester of implementation it was apparent that the site did not work well with the population it was targeted for. At that point the decision was made to redesign the web site to better meet the needs of the University 1 course and its students.

3.2 The New and Improved University 1 Web Site

Re-evaluation of the initial web site also coincided with the University's participation in the California State University system-level Information Competence initiative. This led to the incorporation of the University 1 program within the Information Competence grant project undertaken at California State University, Fresno. The University 1 web site then became an important method for addressing the University's information competence activities. As part of the project, a number of instructional modules that facilitated information competence were developed for inclusion in the University 1 web site.

One of the biggest problems with the original University 1 web site was that while it provided students with many information paths to explore, the lack of directed guidance through the web site and the life enrichment navigational metaphor made meaningful navigation through the site difficult for students. The design of a new interface that clearly categorized the site's content then became a driving force behind the changes to the web site.

As development of the organizational structure of the site progressed it became apparent that the most effective approach was to design a new web site from the ground up. It was decided that the new site would utilize some of the information and resources collected for the initial site but would have a much easier, straight-forward navigational structure. Students would be channeled into more specific learning modules rather than the free-flow format of the previous site and would be very few mouse clicks from the information they sought. The organization of the content was centered around five areas: a *Welcome to University One*,

an *Online Student Handbook*, *Course Topics*, *Special Opportunities*, and *Faculty* information which were all listed as links found on the home page.

Along with the organizational changes, a new graphic look was designed for the web site. The new look simplified the page layout, eliminating the cluttered layout of the previous web site and adding more white space for easier readability. Color and graphic shapes were also used to provide a uniform design element for each page which included the category headings and navigational links to other parts of the web site.

4. Conclusion

The evolution of the University 1 web site has resulted in a number of improvements that are reflected in both the organization and content of the site. The clear and direct navigational structure has made access to the site's content easier and more understandable for students. The incorporation of learning modules has increased the site's instructional role in the course and served to provide content information in areas that were limited or non-existent in the textbook. And the University 1 web site continues to play a key role in facilitating the long-term goals of the state-wide Information Competence initiative.

The University 1 web site is an on-going project which continues to expand and evolve. Learning modules will continue to be developed that augment, enhance, or provide the course content and that facilitate information competence for students in the course.

The new University 1 web site is seen as the first phase in the utilization of World Wide Web resources for the program. Plans are underway for a faculty resource web site for University 1 instructors. This site would provide information that would assist faculty in their preparation and execution of the class. Information would include, the generic course syllabus, examples of course topic schedules, teaching strategies, learning activities, and an exam question bank. The third phase of web utilization will be the development of an online version of the course.

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Searching the Web without losing the mind - traveling the knowledge space

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Visionary terrabytes

Nicholas Negroponte described a vision in his book "Being digital" (1995), his dream of the ideal interface: "Computers" that are human-like. Such a human-like interface would have the ability to communicate with men in a human manner. Negroponte is well aware that there is no computer that understands language as we do, up to now. Although in some restricted areas of language recognition some success has been achieved, no computer system incorporates something like "meaning" or "understanding" (see the „Being digital Cyberdock": http://www.obs-europa.de/obs/english/books/nn/bdintro.htm)

Vilm Flusser, the European philosopher of the Electronic Age, envisioned a world where no human being is working but all men are engaged in solemn cogitation, being part of networked human-computer brain (see the Flusser surfboard http://www.snafu.de/~klinger/flusslnks.htm). Hans Moravec, director of the Robotics Institute of the Carnegie Mellon University, states that in the year 2050 the evolution of computer systems will outperform the natural evolution having the capability of more than thirty million instructions per second (MIPS). Therefore, the human race will only survive as hybrid creatures, something between human being and computer virtuality (see Moravecs home page: http://www.frc.ri.cmu.edu/~hpm/).

Figure 1: Communication with the robot Xavier from Carnegie Mellon University is graphical, remote, and speech-driven. A real-time, speaker independent speech recognition system and a text-to-speech board provides speech generation.

Reality bites

Each user of the web search engines, like Alta Vista, Yahoo and Excite, experiences a reality that is far away from these far reaching visions: Relevant information is buried under thousands of irrelevant links - many of the links are not valid any more and information in the web tends to be of low quality. The situation is even worse, if content providers are concerned: As most content can only be found and accessed by world-wide search engines, the content

provider can hardly influence at what time, to what extent and in what kind of indexing his content will be provided by the search engines, that is, the broker governs the provider.

Whereas the Hypertext Transfer Protocol (http) based on TCP/IP indicates important progresses in computer networking and routing, the Hypertext Markup Language (HTML) stands for the stone age of structured data storage. Fixed links and HTML references elicit inconsistent and incomplete document and link structures. Even basics of data storage, such as normalization of data including data about links, are a 404: They simply do not exist! Therefore, it is not too surprising that maintaining large web severs leads to serious problems. A first solution is: Do not use HTML, use a database, which generates HMTL. Up-to-date web servers, such as the HyperWave server (which was developed by Hermann Maurer, program chair of the WebNet), help to maintain huge amounts of linked pieces of information easily. Basic concepts are: The use of object oriented databases in a multi-user environment, automatic link generation and management, a variety of navigational and managerial tools for the web master and tools to engage the user, such as annotations and flexible content views (see http://www.hyperwave.com).

I don't want to address other important problems, such as the storage and linkage of audio-visual media, which are facing important progresses through the definition of MPEG-4 (see Motion Picture Expert Group: http://www.cselt.stet.it/ufv/leonardo/mpeg/index.htm). An adequate database and technical concepts for audio-visual media form the technological platforms for the Electronic Age. But: Technology solves only technological problems. The accessibility of information depends on the ability of the users to navigate through the knowledge space, to understand texts, images, videos, and to understand how to use the navigational tools.

The myths of multimedia and hypermedia

Most of the hypertext systems are implemented by computer scientists and technical staff. Therefore, they focus on the technological side of the site and not so much on the psychological and pedagogical aspects. This may be the reason, why several multimedia and hypermedia myths managed to survive more than fifty years of psychological and pedagogical media research (I let this kind of research start with Edgar Dales book "Audiovisual methods in teaching", 1946, New York: Holt, Rinehart & Winston). Here are the three most popular miss-understandings:

Myth 1: More media leads to a better understanding

As of today, empirical research has not been able to support the enthusiastic visions of multimedia. In their most recent meta-analysis, Chen-Lin and James Kulik (1991) examined 248 research studies about computer-supported learning. 150 studies failed to show any significant effects. The other studies showed only a slight advantage of multimedia over textbooks or lectures: Error rates of simple retention tests were reduced between 5% to 15%, problem solving was hardly enhanced, and study time was reduced between 20% to 70%, with an average reduction of time about 30%. Considering all studies included into the meta-analysis, multimedia produced only a small effect (Hasebrook, 1995a). Although, multimedia seems to save some time and reduce simple learning errors, it has not been found be very effective as a problem solving tool. Clark and Craig (1992) reviewed several meta-analysis about the efficacy of multimedia supported learning. They draw the following conclusions: (1) Multiple media are not the factors that influence learning, (2) the measured learning gains are most likely due to instructional methods, (3) the aspects of picture superiority and dual coding of texts and images have not been supported.

Fortunately, however, there are also some promising studies showing that multimedia could potentially facilitate the learning processes. The Software Publishers Association (1995) reviewed the effect of instructional technologies in 133 school studies from 1990 to 1994. They stated that there were better test results, an increase in self-reliance, and a closer interaction between students and teachers. Similarly, Boettcher (1993) collected 101 success stories in higher education in his book. Thus, multimedia can help people to enhance communication, motivation, and self-efficacy. This, however, does not necessarily lead to better learning rates but it could potentially facilitate the every-day life in schools and universities.

Myth 2: Hypertexts help to convey structural knowledge

Picking (1994) observed users of a hypertext stack about Jazz music while solving different tasks: To get a brief overview users stick to the paging facilities and the subject index; to perform a goal directed search they rely on key

words and indices; only if the users are free to get an impression of the system, they use hypertext links more frequently. Retterer (1991) tested whether the use of hypertext features leads to better understanding. He compared three conditions: The first group read a written text, the second group read the same text on a computer screen, the third group studied with a hypertext, which contained links between that parts of the text where names and cities are mentioned and that parts where they were explained. Retterer (1991) found that learning with hypertext leads to the best results. Crain (1994) compared lectures, video, and hypertext in a course about public relations. She found video to be the worst learning condition when tested immediately after having finished the course. She found no differences, however, four weeks later.

Many authors claim that hypertext studies convey different or contrary results, because study setting and user skills are not sufficiently regarded. Glowalla and Hasebrook (1995) conducted studies about the effect of user skills and study setting on the use of hypermedia courseware. 52 students participated in a hypermedia learning course, that consists of five consecutive lessons. All of them were novice hypermedia users. In the first lesson they are "unskilled learners", in the fifth lesson they were "skilled learners". Four month later, 43 of these 52 students attended a relearning course. All students received exactly the same course materials and configuration of features of the hypermedia system as in the learning sessions. The students practiced different relearning strategies in the lessons 2 to 4. Therefore, in the first lesson they were skilled learners, but "unskilled relearners". In the fifth lesson, they were "skilled relearners".

Hypertext links and maps were used most frequently by skilled relearners, informational tools, such as a glossary and a table of contents, were used more often during learning than during relearning. Many other studies have confirmed that hypertext enhances learning, only if the individual skills and – especially verbal – abilities match the demands of the learning task and the hypertext system (Reynolds & Danserau, 1990; Barba & Armstrong, 1992; Barba, 1993; Mayer & Anderson, 1992). In conclusion, it is necessary to teach users strategies and concepts to use a hypertext. Additionally, it is necessary to adapt the system to individual abilities and the overall learning environment (Lajoie & Derry, 1993).

There are only few empirical studies which evaluate the on-going use of hypermedia in higher education. One example is the report of Berg and Watt (1991) who compared hypermedia in competition to a classroom lecture, hypermedia supplementing a lecture and hypermedia replacing a lecture. They draw the conclusion (pp. 119): "Objectively the academic performance of (hypermedia) users was not different from those attending classroom lectures... Although positive about (hypermedia) technology, they indicated that they would prefer to use it as supplement to lectures and books."

Myth 3: Web is easy, print is tough

As web-based training refers to multimedia and hypertext, it is clear from what has been said before that appropriate learning results will not be achieved easily. Salomon (1984) showed that audio-visual media does not lead to better retention automatically: Children considered television to be easy and printed matter to be tough; therefore, they learned from television, only if they were instructed to prove how much they could learn watching television. Therefore, it is important to activate and engage the learner into the knowledge building process. The learner, who is not engaged, does not learn: This is the lesson that Jonassen (1993) learned when testing several hypertext indexes and maps. Although he provided well structured hypertext links, maps and tables, the users were not able to grasp the main concepts and to transfer them to related fields. Only one group was superior to all other groups: They had used a hypertext generation tool, called LearningTool, that allowed them to develop their own hypertext map.

How can the effectiveness of multimedia over any other form of learning be improved? There are three important factors: (1) Interactivity, (2) communication, and (3) individualization (or adaptability). An enormous amount of information can be stored and accessed easily. Interactive systems can support the responsible use of electronic media and international communication, such as language learning when students from different countries communicate via e-mail or computer conferences. Computer applications can adapt to preferences, knowledge, and abilities of single students (Hasebrook, 1995b). On-line databases can provide up-to-date information while books tend to be out-dated as soon as they are printed. Homework assignments, such as read the next 50 pages until Monday, do not make a lot of sense anymore. Instead, students may be more motivated to measure the air pollution in their hometown to find out that it is higher in the center of the town. Carefully designed animation, feedback facilities, and simulations can help teachers overcome the weaknesses of study materials and to focus more on the

learning and communication processes. The learning places of the future won't be dim places filled with computers and isolated students in front of the machines. There will be an intensive interaction and communication between teachers, students, and other learning places from all over the world. Computers and multimedia applications are important tools to support this development but they are not the solution to all problems.

When the model is more complex than the reality

Most graphical user interfaces do not support the capabilities of our perceptual and cognitive systems. For instance, the popular three dimensional statistical charts cannot be inspected very quickly, because or visual system focuses on small details or gives an overall impression: Certain details pop-out of the scene, a general figure, a Gestalt, is projected into a scene. But 3d statistical graphs, diagrams and hypertext maps, like moving maps and fisheye views, need a continuos flow between details and general figures which have to be linked to certain meanings. But our mind did not evolve in rectangular block worlds and meaningless linkage maps. Natural scenes support understanding, if the scene is appropriate for the meaning of the data displayed in the scene.

The Institute of New Media (INM; http://www.inm.de) and the Bank Academy (http://www.bankakademie.de) are co-operating in the development of innovative web-based learning tools. One project of the INM is SkyLink, a model of the city of Frankfurt which contains the skyscrapers of the major banks. An avatar allows to float around in the scene and to choose different content views, such as the cash flow between the banks. While a real building is always more complex than the architects plan, the usage of virtual models tends to be more complex than the plan. We aim to connect VRML models and the interactivity of MUDs (Multi-user dungeons) in order to provide the students of the Bank Academy with a deeper insight of real (but partly invisible) processes (visit the SkyLink browser: http://www.inm.de/people/bernhard/skylink.html).

Figure 2: The screenshot of the SkyLink project of the Institute for New Media presents the architecture of the city of Frankfurt/Germany as a graphical user interface, a hypertecture.

This hypertecture differs from the desktop metaphor by its immersion. Additionally, there have to be immediate system responses: If it takes more then 10 seconds to understand the basics features, the user moves on to the next site. Known architectural elements can be used and transformed to semantic symbols of information: For example, the skywalk is not meant to stroll on but is used as a semantic element promising some interesting events to go along with. A door like the skystation entrance has to be visible from far away and has to be big enough to float through it - even if the visitor is not well trained. In this way, architectural elements become icons, and natural environments become virtual learning environments.

SHOEs for the web walker

Obviously, we have to use a proper technological base and to engage the user if learning, understanding and problem solving is the objective of information sharing in the web. But we have to understand what understanding means in order to come up with tools to support understanding. Understanding certainly refers to internal activities like to grasp the meaning of something. How has meaning brought to the web, so far? There are three prominent ways:

> (1) Keyword subject indices. (2) Catalogs painstakingly built by hand. (3) Private robots using ad-hoc methods to gather limited semantic information about pages, such as Everyone with links to me. It is easy

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to see the disadvantages of all three techniques. All recent searching and indexing techniques come with about 25% relevant items responding to a retrieval query. Projects from the University of Stanford and the University of Maryland, for example, try to overcome the semantic barrier in the web information technology.

The University of Maryland developed the Knowledge Query and Manipulation Language (KQML), a language and protocol for exchanging information and knowledge. It is part of the ARPA Knowledge Sharing Effort which aims to develop techniques and methodology for building large-scale knowledge bases. KQML is both a message format and a message-handling protocol to support run-time knowledge sharing among robots. A related approach is Simple HTML Ontology Extension (SHOE) which allows to give HTML authors the ability to embed knowledge directly into HTML pages, making it simple for user-agents and robots to retrieve and store this knowledge. SHOE is set of HTML tags that adds a knowledge markup syntax; that is, to enable the publisher to use HTML to directly classify the web pages and detail the web pages' relationships and semantic attributes in machine-readable form (for an overview see: http://www.cs.umd.edu/~seanl/kr.html). Similar projects are Harvest (see http://harvest.transarc.com/) and the ontology servers of the University of Stanford (look up the ontology frame editor: http://www-ksl-svc.stanford.edu:5915/FRAME-EDITOR/). Similar projects are run at several institutes (e.g. the MIT: http://www.medg.lcs.mit.edu/doyle/projects/ontology/; an overview about web ontology is given by Doeben-Henisch at: http://www.inm.de/kip/lit-inf-retrieval.html).

The new traveling agents: Knowledge Robots

The INM and the Bank Academy are currently implementing a knowbot scenario to enhance learning and working in banks. To fulfill the requirement that knowledge (explained in a certain language) can be learned by an intelligent user's interface, two strategies are near at hand: (1) Robots are built, which are like human beings (the vision of Hans Moravec) or (2) virtual agents are constructed within appropriate environments which will be similar according to a functionality based on the establishment and usability of verbal meaning. Strategy one is followed in the Real World Computing Program of the Japanese MITI. Strategy two forms the basis for the Knowbotic-Interface-Project (KIP) of Gerd Doeben-Henisch from the INM and myself. We think, that the hypothesis is valid that sufficient isomorphy of the data-structure and the functions are enough to achieve interesting results (see http://www.inm.de/kip/kip.html).

Within the context of the Knowbotic-Interface-Project the virtual agents are called knowbots. This term has been coined by Doeben-Henisch in order to establish a distinction between knowbots and the robots of the Real World Computing program, and to avoid the still diverse use of the term 'agent' within the context of AI (an overview is provided at: http://www.inm.de/kip/KBOOK/models-others.html). Crucial for the knowbots within the project's context is their ability to learn knowledge about the virtual world they live in. They must also be able to learn an intelligible language in relation to this knowledge. Since the exact functionality of human ability to learn and human usage of language is still impenetrable, all varieties of modeling experiences have a hypothetical characteristic. Considering this the following draft of a knowbotic interface can only be seen as one possible suggestion among other promising alternatives.

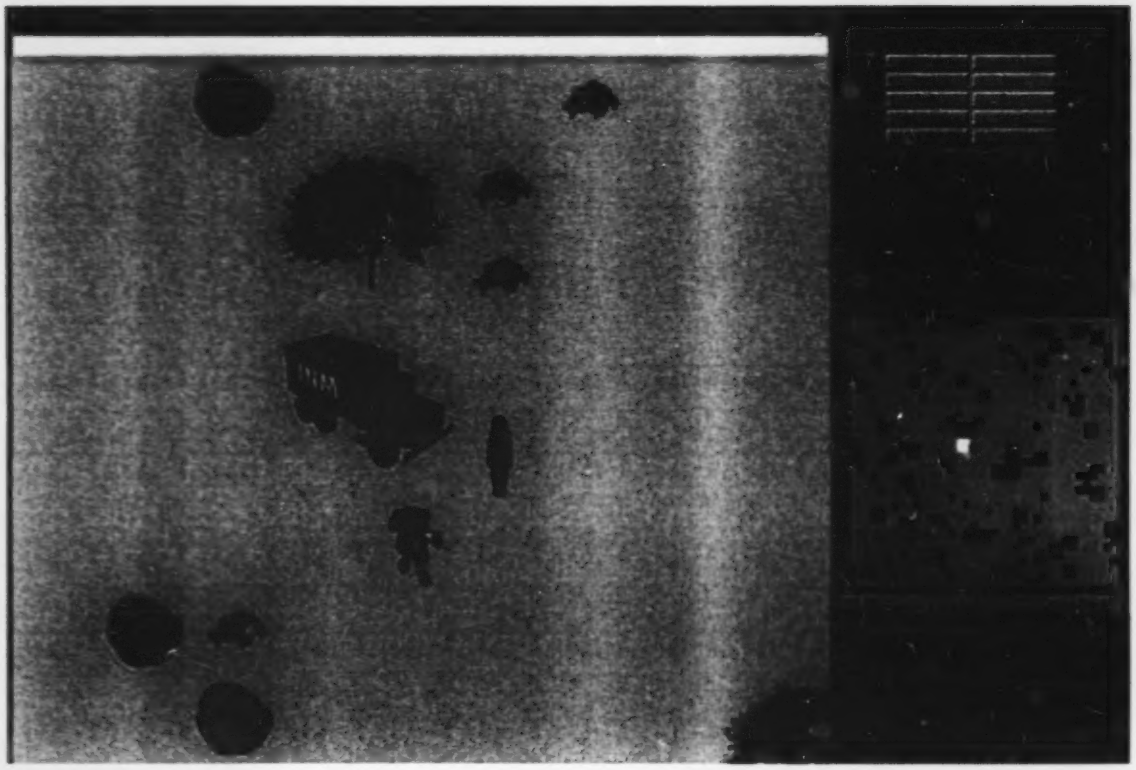

Figure 3: Screenshet from a knowbot experiment - an avatar (a female figure) and a knowbot are interacting in a desert scene.

Knowbots in web-based vocational training

The research on constructivism and situated cognition support the idea of a new roles for teachers and interactive learning systems. The main ideas of constructivism and situated learning are: Learning as active construction of knowledge instead of passive absorption of knowledge. Additionally, physical and social aspects of the learning situation have to be considered. Central theories of situated cognition led to corresponding instructional models such as „anchored instruction" (overviews are provided in CTGV, 1990; Collins, Brown & Newman, 1989; Duffy & Jonassen, 1992; Gerstenmaier & Mandl, 1994).

State of the art in pedagogical and cognitive research provides a number of key concepts: (1) Constructivism, (2) situated cognition and situated learning, Cognitive apprenticeship - especially in vocational training, (3) knowledge transposition, that is the transformation of expert knowledge in practical knowledge and in practical competencies, (4) enhancing the learners' motivations (although the role of intrinsic motivation seems to be overestimated in the recent literature), (5) definition of the teaching process as an active coaching and guidance process; immediate feedback based on adequate evaluation criteria.

We reviewed rule-based expert systems, neural networks, genetic algorithms, fuzzy logic, and advanced statistical systems in order to check their appropriateness for vocational guidance and education:

(i) Neural networks are superior to many statistical methods because they provide an easy way for non-linear forecast. They are effective in recognizing patterns in noisy or incomplete data. Therefore, neural networks are suited for career counseling where clear rules cannot be formulated. Unfortunately, it is impossible to explain the reasoning of neural networks to users. Explanation of the underlying reasoning, however, is a crucial point in counseling and education.

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(ii) Genetic algorithms are successful in searching huge databases and large optimization problems including timetabling, job-shop scheduling, and data-mining. Moreover, genetic algorithms can provide explanations of the decisions they produce. The performance of genetic algorithms, however, is strongly affected by the representations schemes employed. Additionally, setting the parameters such as mutation rate and crossover need extensive experimentation. This contradicts our goal to develop a algorithm which is simple to use and simple to maintain.

(iii) One of the obvious advantages of fuzzy systems is their capability to deal with imprecise data using a rule-based knowledge base which is easy to understand and explain. This advantage, however, tuns out to be a problem if clear rules can not be elicited.

(iv) While interviewing 118 experts for career counseling, we learned from the interviews that the experts use rules to guide the counseling process, but they do not rely on any detectable rules when matching career options and personal traits. Thus, we had difficulties to translate their expertise into simple If-then-rules (Hasebrook & Gremm, 1996). Our statistical analysis of the expert data revealed that only very few statistically significant factors are discriminating hundreds of career options. We aimed to take advantage of this fact and reviewed statistical methods to match multi-dimensional data sets. We implemented an algorithm which allows easy explanation of reasoning, easy updating and maintenance, and incorporation of precise and imprecise data. Above all, no paradox system responses could be observed (Hasebrook & Nathusius, 1997; see http://www.medialog.de/t0.html for a German implementation).

In a study with seventy-five students we were able to show that individualized information provided by a brief test followed by system generated suggestions lead to better retention of relevant information than multimedia elements, like digital video and photo: Our subjects recalled 45% of the information after having used the testing facility but only 33% after having watched videos and photographs accompanying the explanatory texts.

Statistical methods, however, represent a static set of factors. Thus, it is impossible to set up a dialogue between human users and the computer system. Moreover, static systems do not learn from users interactions and do not adapt to the communicational needs of the users. Knowbots may help to overcome such obstacles by representing relevant aspects of the users needs and knowledge. They may be able to provide individualized communication with the user and - by communicating with each other - to optimize counseling and learning systems.

Little is known, however, about the effects of tele-cooperation on corporate culture, learning behavior, and communication processes (Sproull & Kiesler, 1991; Hasebrook, 1996). Electronic conferences can provide several advantages as Sproull and Kiesler (1991; Kiesler, 1992) discovered: Personal communication takes less time but leads to agreements less frequently. Additionally, electronic conferencing allows for a more symmetrical participation than personal discussions, mainly because social cues and social status are less important. We expect to enhance these advantages by using knowbot technology (a demo is provided at: http://www.inm.de/kip/APPLETS/KIP_2.061/applet_no_2.061.html).

Bank Academy and INM are implementing Intranet-based learning environments that allow for synchronous and asynchronous communication within learning groups and support workshops. Two evaluation studies are conducted in March and May this year: The first study examines the impact of Intranet-based testing and simulation tools within a bank training framework. The second study examines the communication behavior of learning groups in banks using web-based training systems based on HyperWave servers.

We are aiming to conduct a study which comprises all relevant factors, namely the user engagement, the user interface design and the accessibility of relevant information. The design of the study is based of three factors, each of them in three versions:

- User engagement: Factor users task - (1) get overview, (2) learn for test, (3) solve work problem.
- User interface: Factor GUI - (1) text based hypertext, (2) hypermedia maps, (3) hypertecture.
- Information access: Factor Index - (1) keyword index, (2) catalog built by human expert, (3) knowbots.

There will be three different groups of 60 users each working with different versions of the bank training system. We hope that the results of study will give us a closer look on how human beings interact with different kinds of meaningful information displayed by different user interfaces embedded in different contexts. First results from the pilot studies and this comprehensive study will be presented at the WebNet conference. We are sure that more than recent visions will come true: Computers wont be like humans, but they will be partners in an on-going communication and learning process. Rules and systems for a real men-computers dialogue will emerge in the near future. This will not result in a simple extension of the antropomorphism that can be observed, if tools like hypermedia, virtual reality or AI-based dialogue system are used. Inter-connected computer systems will learn to support understanding in the human users, and they will bring meaning to the World Wide Web.

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"With Performance Outcomes in Mind: Embedding Performance Support Elements in Web-based Course Design."

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Abstract: This paper describes a case study currently in progress of how a Web-supported course in Multimedia and Instructional Design was designed, implemented and evaluated using performance support elements aligned with performance outcomes for one section of teacher education students. The evaluation results of this case study will be based on a course survey questionnaire, the themes of the students' journal analyses, a profile of the student projects, and the performance outcomes' data.

1. Performance Outcomes

The exponential growth and information and the rapid development of technologies is transforming education as we have known it for the last fifty years moving from a teacher-centered model of tell and test or a "transmission" view of knowledge to a student-centered model of constructivist teaching and learning. This shift is occurring because the new realities of the knowledge age are changing not only how we view learning (Slattery, 1996; Wheatley, 1994) but also what students will need to know and be able to do. Now when our students graduate, they must have much more sophisticated skills and abilities, such as creative problem-solving, accessing and managing vast quantities of information, communicating effectively, working on teams, and learning how to learn.

With performance outcomes in mind, web-based curriculum design can embed "performance support" elements that provide scaffolding, support and functions at the critical moment of need for the learner. The result is a better fit between the learner and what the learner needs to do in the context of a performance. Current thinking in lifelong learning stipulates that the most powerful learning is that which occurs in response to challenges being faced by the learner and that allows for *immediate* application, experimentation, and adaptationî (Sparks and Hirsch, 1997, p. 52).

2. Performance Support

Electronic performance support systems (EPSS) is both a way of thinking and a set of strategies for using technology to augment work. Gloria Gery (1991) defines EPSS as the use of technology to provide on-demand access to integrated information, guidance, advice, assistance, training, and tools to enable high level job performance with a minimum of support from other people. As schools and universities implement educational reforms that include performance outcomes and benchmarks as assessments, the students have similar needs to workers who need specific resources to complete their tasks successfully.

Web-based curriculum can be designed to support the learner's performance and assessment so that the emphasis is on gaining expertise as part of the learning experience rather than having students fulfill the course requirements and hope for the best. As Larry Friedlander points out,

"This technology invites us to embrace process, to enjoy the *journey* as much as the goal. Because it asks its users to intervene with their own choices and opinions, it can challenge authority and help deconstruct received, standard forms of knowledge" (Friedlander, 1997, p. 174).

3. Designing in the Performance Support Features

Designing in these features takes time, but the support provided for all the students is well worth the effort. Now students can use the materials, work on design teams, and discuss their learning far beyond the allotted class meeting times.

3.1 Course Syllabus, Schedule, Bibliography, and Instructor Link

The course syllabus, schedule, a bibliography, design templates, and instructor's Email address and other information can all be downloaded.

3.2 The Learner Profile

Students take a learning inventory profile and see how the class is made up of many different learning styles. They become more aware of how styles influence multimedia software designs.

3.3 The Performance Outcomes

These outcomes are based on the content, procedural, cross-competency process and lifelong standards. These include instructional design principles, learning research and pedagogy, multimedia design principles, teamwork, communication, reflective analysis, and others. For each of the assignments in the course, a set of criteria and rubrics is provided so that students know exactly what is expected. Rubric levels range from novice to expert.

3.4 A Learning Community Environment

Students and teachers build a communal knowledge base similar to ways that scientists and researchers communicate. This helps support the learning experience and the communication performance outcomes. Learning takes place as students write, discuss, annotate, describe, and reflect on their learning in their journals. This reflective process balances the "doing" process in the curriculum. A leading educator, Ann Berthoff reminds us that: "Our job as teachers is to devise sequences of assignments which encourage conscientization, the discovery of the mind in action" (Berthoff, 1990, p. 25).

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Providing State-wide Access to Information Resources: Indiana's INSPIRE Project

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INSPIRE (Indiana Spectrum of Information Resources) is Indiana's Virtual Library on the Internet. Its successful launch on January 15, 1998 represents a milestone in the evolution of statewide virtual libraries. INSPIRE debuted with commercial periodical databases and encyclopedias from EBSCO, a handful of z39.50 compliant library catalogs, and an opportunity for information professionals to bring added value to traditional library services. While publicity has been limited to the library community, the number of database searches reached nearly 1.4 million in the first six months of operation, with over 425,000 full text articles downloaded. The mission of INSPIRE is to provide residents of Indiana with equitable access to electronic information resources that enhance the quality of their everyday lives, the depth of their educational experience and the economic prosperity of their communities; to provide high-quality information resources that have been evaluated based on criteria that include richness and authority of content, reliability of source, ease of use, and suitability for Indiana residents. To ensure access to these resources for all residents of all ages, in all economic circumstances, in all walks of life and in all regions of the state of Indiana through Internet connected computers in homes, businesses, schools, and libraries. Guaranteeing this level of access with a limited budget has lead to creative ideas and solutions for user authentication.

What distinguishes INSPIRE from other statewide information access projects is the intention to provide access to home users. Traditionally, library projects have authenticated users via IP addresses/domain name or library barcode. There were no models available for extending access to any state resident without requiring a person to register with a local library. At the same time, future plans for INSPIRE, purchasing additional databases that may be available to some but not all libraries in Indiana, interlibrary loan/document delivery, and reference services, require sophisticated authentication schemes for implementation.

When INSPIRE was first available nearly all the public schools and libraries in the state as well as homes and businesses with connections to Indiana-based Internet service providers had access to the service. IP addresses and domain names had been collected from schools, libraries, and local Internet Service Providers. A proxy server, Squid, was set up. Access to a z39.50 web server, SiteSearch, and hence the commercial databases were limited to IP addresses/domains entered into an access list for the proxy server. While this mechanism has worked well in the early stages of the INSPIRE project, it offers no opportunity for expansion. For example, an institutional name could not be linked to an IP address for purposes of controlling a list of available databases or setting up interlibrary loan properties.

As INSPIRE evolves, a major challenge is to develop a user authentication system that makes the system accessible to all Indiana residents and allows services that are available only to particular institutions, while maintaining a modicum of security. Additionally, it is not desirable to limit access to INSPIRE web pages in any way. Planning for access needs involved considerable research into existing authentication options. Most of the newer technologies seemed to rely on an existing database or at least the idea that an organization had an identifiable user groups, usually employees or students or, in the case of commercial enterprises, would register folks, regardless of geography. The more realistic solutions, notably username/password scheme (htaccess or database), cookies, and proxy servers, failed to address how to identify that someone was from Indiana in the first place. It became clear that there are two issues at work for establishing an authentication system for statewide access. The first one is how to verify that a user is a resident of a particular state and the second one is how to maintain information about valid system users once residency is verified.

At first glance, digital certificates appeared to address both issues as we could contract with a vendor that issued certificates with locality information. The problem was with base level certificates only check a person's email address, so the state/province would not be part of the certificate. Address information is provided with class 2 digital ids; however, that level of security was out of our price range and was overkill for our security needs. Another high tech idea for verifying residency was to make arrangements with the division

of motor vehicles to use their database, which is available online. While this idea has merit for the long run, both systems need to be more fully established before trying an interface. It also has limitations for authorizing k-12 and college students. The most reliable, albeit slowest, means for verifying an address seemed to be the U.S. Postal Service. A user will fill out a registration form on the Internet. The data will be capture to a file and manipulated so it can be printed onto a self-mailer form with a one-time use password. The password will allow someone to generate an entry into a permanent database entry.

With the verification issue resolved, there were still lingering questions about the best way to maintain user information as well as periodically re-check the validity of a person's residency. The later was solved with the requirement that database entries had to expire. (A plan for re-validating can wait until other components are in place). Further discussion and planning centered on whether to use a more traditional SQL based database or digital certificates. The latest release of SiteSearch software is developed to use a mini-SQL database for authentication. Certificates were intriguing as a state of the art technology and what looks to be a lower cost per user in staff time. Since the x.509 standard includes fields for organization and organization unit, it would be possible to setup institutional access parameters based upon data in a certificate. Ultimately, digital certificates could meet all our authentication needs. To speed up implementation IP addresses/domain names with institutional information will be stored in the SQL database.

Options for issuing certificates were evaluated with the idea that they would be used primarily for home users that would be allowed access to Inspires core services. Due to budget constraints, the only way to proceed was to become our own certifying authority (CA). The drawback is that web browsers do not recognize the CA making downloading a certificate more cumbersome, particularly for Internet Explorer users. After setting up software from Xcert, Netscape, and the free SSLeay tools, the Netscape Certificate Server was chosen. Xcert was eliminated because the certificate database it created was not accessible to the SiteSearch server. SSLeay required significant programming expertise to implement a backend database. An understanding of United States encryption law helps too. Netscape uses an Informix database and has hooks directly into its LDAP server product. Product literature indicates that later releases of Netscape may work with additional database products. If so it should be possible to use mini-SQL for both types of authentication. The web interface makes the server setup almost trivial.

While the ideal is to have one system for authenticating all users, lack of time for development work has forced to use of two distinct systems. At the moment the proxy server is still used to authenticate IP addresses/domain names. This will be replaced by a SQL database in the coming months, which will allow for institutions to access different databases, etc. Those entering the system with a digital certificate for authentication will be able to get to the core services. It individual libraries will be given a choice about patron access to additional databases and referring URLs will enter the mix of authentication options.

With digital certificates the way the process works is that once a user fails the IP authorization check, he/she will be given an opportunity to fill out a web form with basic information—name, address, email--. Perl scripts will be used to capture the form data, generate a one-time use password, and output data for a self-mailer. The user will also be given the URL for the INSPIRE digital certificate server. The password will be required for a user to automatically generate a digital certificate that can be downloaded into her browser. The web server associated with the SiteSearch software will check for the digital certificate before allowing access to commercial databases.

The digital certification application for INSPIRE is still very much a work in progress, with testing set to begin in August 1998.

A Networked University as a Joint Venture - Challenging the Trad. System

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Abstract: Internet and WWW challenge higher education to re-think traditional, academic ways of organising universities and colleges, and require new pedagogical approaches to the provision of knowledge. This paper presents organisational and pedagogical arrangements for a joint, networked university, established by four Norwegian institutions - and also open for other institutions to join in.

Among the organisational aspects, attention is drawn to formal arrangements, commitment and objectives related to national demands and joint activities within ODL. Tasks like economical, technical, professional and pedagogical organisation, are specified in a partner contract, signed by each partner institution.

Pedagogical aspects are discussed with a focus on professional collaboration between university researchers and teaching staff for the development of ICT based learning environments. Different pedagogical models are presented, from the simple 'electronic correspondence school' to more advanced ICT supported, problem based learning and collaborative learning where students share responsibility for support and learning activities.

Background

Industrial leaders as well as public administration claim that universities and the traditional, higher educational system are not able to meet the demands of required, up-to-date education. They express clearly a lack of faith in the system to meet new challenges, and tend to look for other solutions and resource centres, outside the existing academic system, in order to develop and offer courses and studies that fill their needs. New, private enterprises are more flexible to adjustments and tailor-made training programmes and packages, than are the large, public universities, which are bound by traditions and regulations.

National white papers and international reports point out needs and sketch different solutions to the present situation and future requirements. The growing demand for lifelong learning and increasing requests for new competence can only be met by developing open and flexible learning systems. Companies can not release all their workers, technical and administrative staff for lengthy periods of time in order to upgrade their competence or raise their formal, professional level. Such education and training should be available at their desk, as a complementary activity in their daily routines. This requires flexibility and availability of learning at the workplace.

Typical for the situation in Norway is a very strict labour market, with an extreme lack of qualified personnel in several fields, and particularly in areas related to new information and communication technology (ICT). Politicians and governmental agencies do not see any immediate solution to the problem, and can only recommend import of skilled staff from abroad. In the long run, however, this is far from a desirable situation. Experiences from different ODL projects, both nationally and as part of international programmes (DELTA, Socrates etc.) has during the past 4 - 6 years created a basis for further development in the area of ODL. It is believed that this is a possibility of both offering industry and public services the learning facilities they are asking for, and for making higher education more attractive to individual students at all ages and stages of life.

NOL - Networked Open Learning

Based on experiences from the European DELTA project, JITOL[1], four Norwegian institutions, in 1994 made a joint, national offer of higher education through ICT based NOL. This project is known under the acronym NITOL[2], and has proved very successful with respect to popularity among students around the country. The diagram below illustrates the impressive growth of an activity that was mainly initiated for R&D purposes, and not for mass attendance. Marketing was close to nil at the start, and has continued at very low cost.

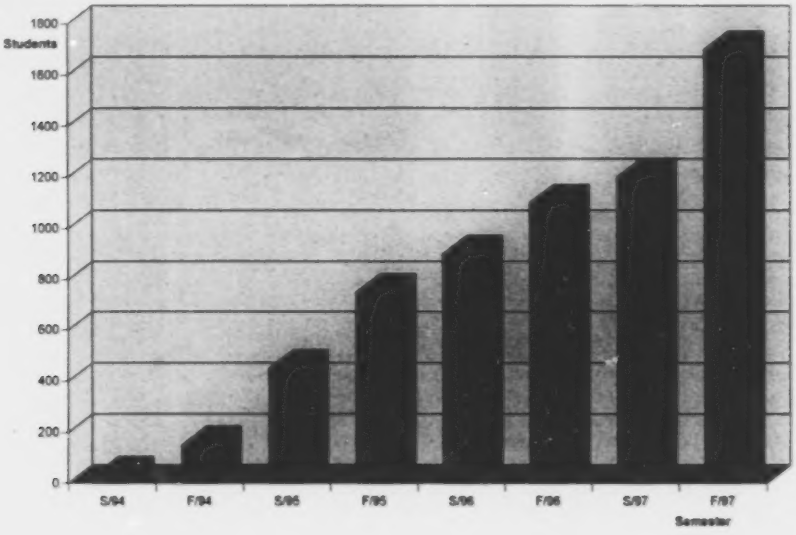

Fig 1: Students registered for NITOL courses

The rapidly growing number of learners attending the program clearly indicates a market and a demand for courses and training. Since this is outside the regular university activities, students have to pay fees to cover the costs of delivery and tutoring. Nevertheless, lots of people see the advantages of availability of higher education *when* and *where* it suits them, so important that they will rather pay than attend regular study systems free of charge.

Observing these preferences in the population, the project group of NITOL has concluded that it is necessary to improve and extend the services of ICT-based NOL. The restriction of limited resources also makes it necessary to look for rational and efficient ways of providing these services. Collaboration between institutions with similar or complementary competencies and specialities, exchange of products and knowledge, openness in research and development work, all seem to be possible strategies to obtain the set goals. The limited project initiated by a few persons within four geographically separated professional environments, would therefore have to be raised to an institutional level in order to expand further. This is the background for now embarking on an intentional agreement between the four institutions to establish a networked university (NU), or a virtual learning institute (VLI).

Organisational aspects

[1] JITOL = Just In Time Open Learning, aimed at upgrading of professionals in different fields through electronic networks

[2] NITOL = Norway-net with IT for Open Learning, where Norway-net refers to the national network of higher education

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Institutions

The 4 institutions involved are all part of the same national network, Norway-net. This expression was introduced through a governmental white paper in 1990 (Stmeld.nr 40, 1990/91), describing a professional network of higher educational institutions in Norway, in order to share responsibilities for the different academic fields and subjects. The 'net' did not necessarily imply electronic or digital connections, but did rather denote professional and human relations between academic societies in the country. Now, since the mid-90'ies, Internet and modern IT have gained such popularity that it is quite natural to include ICT as an important infrastructure to facilitate the Norway-net. This is also a natural link to previous experience from the JITOL project, where new ICT was a strong feature. [Haugen & Ask, 1996b]

Characteristics and specialities of each of the four NITOL institutions are basically complementary,

- a large university (NTNU, 20 000 students) with a wide spectre of subjects and professional study programmes, from undergraduate up to Ph.D. level, well known for their specialities within technology and science, represented in NITOL by their Department of computer technology and information science
- two fairly big regional colleges (HiST & HiA, 4-6000 students), both with strong departments of engineering and computer science, a wide spectre of other professions and subject areas, and represented in NITOL respectively by their departments of telematics and computer science
- one smaller college (HSH, 2000 students) with a more narrow spectre of professions, a strong department of teacher education, and represented in NITOL by the division of educational information science

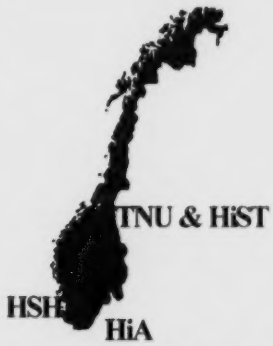

Fig. 2: The four NITOL institutions in Norway

The strong representation of ICT personnel in the project was partly a heritage from a previous project (JITOL), but also intentional to choose subjects and courses involving students and tutors that would not back away at first encounter with technical difficulties. When the project started in 1994, ICT was not as customised and user-friendly as it is now in 1998, and represented a major challenge in itself.

After taking an initiative for establishing the Networked University (NU), the original four partners have invited other universities/ colleges to join the organisation in the next phase. Rules for this expansion are discussed between leaders of the new organisation.

Objectives

The intentional agreement specified three groups of objectives,

- international goals, including positioning our country in the global society of education, research and development, and contributing to international exchange and understanding as a basis for lifelong learning
- national goals, like improving access to education, filling gaps of knowledge in industry and society, raising the general level of competence, and developing new courses and lines of study that are asked for by industrial and political leaders and employees
- institutional advancement in pedagogical and professional activities, renewing the study programmes, researching new ways of learning - and defining a common policy of academic and educational service development.

The objectives concern both research, development and creation of practical learning environments, stressing contacts with professionals from all walks of life, exchange of products and knowledge, and networked open learning offers to those who want, *when* and *where* they want it.

Economy and technical solutions

A common belief, particularly among politicians and administrators, is that networked open learning (NOL), - or 'distance education' - will be a less expensive way of providing education. This is probably true when it comes to total costs for the society. Experiences so far, however, indicate quite strongly that in order provide equivalent quality of learning, NOL, it requires a lot of effort for initial development and maintenance of learning material, and that tutoring on the network takes more time than simply performing a lecture in a classroom or an auditorium. Students on the net - whether they are local, on campus, or at a distance - have a strong urge to ask for individual guidance e.g. through e-mail in stead of contributing to discussion on a conference.

On the other hand, the total cost for society, including costs of transportation, student housing, costs of living etc., will be lower for NOL provided to the individuals at their home or workplace, compared to the cost if they would have to attend regular day-studies at a university. So the possible extra costs of providing higher education in the form of NOL, is more than compensated by the savings for the individual learners. In addition they are likely to have a better opportunity to meet other obligations in their lives, with respect to family, work and geographical location, in parallel to education.

Technical solutions for providing NOL should be kept at a balanced level, not the most advanced and expensive, and not too old and out-dated for professional use. Both for NITOL and for the planned networked university, the intention is to apply the present standard of ICT at any time. In 1998 this means Internet connections with standard WWW browsers and Windows-/Office software or the equivalent.

Formal organisation

The new NU will start as a joint project, based on a partnership agreement between the four institutions. The intentional agreement suggested some lines of structure in the new organisation, and some ideas on how to share rights and responsibilities between the partners, a board and a secretarial function. Details are now specified in a preliminary partnership agreement, a document signed at the highest level of authority at each institution.

The contract specifies the organisational structure of the networked university (NU). When the organisation is formally established, it is open for other institutions with similar and complementary study programmes to join in or associate. Among the issues that are specified in the contract, we find the following issues:

- Goals and objectives
- Formal status of the NU as a collaborative project, formal management of the project, i.e. with a representative steering committee and its mandate
- Practical administration, i.e. a secretariat for general information, marketing, student registration, invoicing, accounting, updating of the common course catalogue and web-pages, etc.
- Specification of joint responsibilities and tasks, and relations to the individual institutions
- Contract formalities, such as joining/withdrawal by institutions, start and end of contract etc.

The already existing NITOL organisation will most likely continue as a joint forum for research and development, exchange of experiences and academic discussions related to NOL.

Pedagogical aspects

A networked university depends upon inter-institutional collaboration on organisational issues, but it is also a challenge for collaboration between professionals on pedagogical issues.

Collaboration between professionals

Inter-institutional collaboration between professionals can be looked upon from different angels; from collaboration in distribution of limited and well defined learning material, to collaboration in creating a total learning environment.

Collaboration in distribution of learning material is relatively easy to implement in a networked university. This might be as simple as just putting courses together in a common course pool, making a common catalogue of offers etc. [Ask & Haugen, 1996].

Another way of dealing with learning material is to join forces in development of course material. An example here can be when professionals from two or more institutions - even across boarders - join forces in creating a course where no single person or environment has the necessary knowledge or resources to develop it. A NU can really profit from this way of sharing workloads [Retalis, Skordalakis, Haugen, Ask 1997].

A third option is to develop single modules that can be building blocks in several combinations of courses or studies within the collaboration One may look upon single modules as units to compose a course, or look upon different courses as fragments in a puzzle of a degree programme, independent of which institution the building blocks or fragments originate from. This kind of arrangements requires strong co-operation for recognition of credits and academic level.

The many different ways of collaboration between professionals seems to be a strength for a networked university, and is also a main idea and reason for establishing this kind of virtual institution.

Models of learning environment 'inside' a networked university.
It might be a contradiction in terms to talk about a learning environment *inside* an open, virtual organisation. Nevertheless, it is important to create a learning environment, especially when students are more or less 'off-campus' as most of the students attending the NU possibly will be. Normally we think that students attending a NU are adult people, employees in a work situation, individuals looking for up-grading in their spare time etc. We also use to think about adult learners as mature persons taking responsibility for their own learning. Even if this is true, we as professional academic staff members, have a responsibility for making the learning environment for our students as rich as possible. How may we create the best learning environment for our net-learners?

If we look upon a NU as *one* institution, even though it is virtual, we also may think that the learning environment we create belongs to this institution and is a part of the pedagogical work going on inside the institution. We can of course differentiate between one learning environment for on-campus students, and second one for off-campus students. But since a lot of teaching and learning activities apply the same tools and resources, it is both convenient and rational to include all students into the same learning environment. We may have difficulties if one student group have access to learning environments that are out of reach for another group, whether it now be the classroom attendance or the network resources.

Intentionally, a learning environment should be dynamic, adjustable to circumstances and content. It shall evolve and develop according to the environment and the persons involved. It is difficult beforehand to tell how an environment is going to develop, but different models create different opportunities to the environment. We will look at a couple of models for a learning environment which have been practised within the NITOL networked university [Haugen & Ask, 1996a]. The two models reflect activities where each institution acts independent of the others in the network. We will also look at the design of a more complete learning environment for a networked university, where the two models can be 'subcultures'.

The electronic, networked correspondence school
The main purpose for this framework as a learning environment is to have a smooth and simple pattern for electronic delivery of learning material and for return of exercises from the students. The structure is well defined, with a fixed time schedule for distribution of material and deadlines for return of exercises etc., presented in the start of the course. The basic model gives little space for creative or spontaneous student activities or discussions of any sort.

If we add E-mail and electronic conferences to this model, it opens up for a learning environment that supports discussion groups, sharing of experience etc. It brings 'interactive' characteristics from the classroom into the

virtual environment. Students are allowed to ask questions 'directly' to the teacher or tutor through e-mail. Responses will normally come either as soon as the tutor reads the mail, or at pre-defined times.

Another dimension that is now commonly available, is the concept of *hyperstructures* and links to other sources of information. With this included, we are far beyond the potential of a traditional correspondence school.

Experiences from use of this model as a learning environment have been amazingly positive. Amazingly because we thought that this way of using the network could be a bit boring for adult students and that they would not care about using these added facilities. On the contrary, it turns out, they like to stay in touch with the professional tutor - and with each other. The teachers' experiences from using this technique vary from one group of students to another. Even within the same framework, it is hard to tell how the environment will evolve. An example of this net-correspondence model using e-mail and conference facilities may be found at

http://www.idb.hist.no/fag/LO303D-GrunnkursEDB-NITOL/index.html

The interactive learning environment model

In this model we use more of the services and facilities that Internet offers. An example here can be the problem based learning (PBL) environment where students attending the same course are 'forced' to work together in order to bring forward interesting literature and articles on how to solve a defined problem, e.g. by using electronic hyper links to relevant material, which in turn becomes part of the study material or curriculum. This model has moved the learning situation from a classroom or group discussions and reference lists to a workplace on the net where all the students' activities are visible for every other student in the group. In this environment students discuss, contribute in the learning process, submit their own thoughts and ideas of how to solve a problem, analyse each others' solutions and so on. The net is not only a 'transfer medium' for learning material, but it is also the place where the learning activities occur (http://hugin.hsh.no/home/lv/mfag97/home2.htm).

The networked learning environment

A complete model of NOL can contain the two previously mentioned models and all combinations of them, which more or less represent the specific way a tutor and the students create an environment for the actual course. When institutions establish an inter-institutional collaboration, a virtual university, it is important to agree on a common platform or learning environment for the students attending this university. One way is to establish a common home page for this virtual institution, where students get all the information they need e.g.: how to register, costs, equipment needed, exams, courses available, names of teachers, etc. Further more, it is important to make paths from this common arena to the specific course environments. If a specific course is developed by joint efforts from two or more institutions, it is natural that the actors involved in the development also take part in running the course. At least they should have access to a common learning environment where all of them contribute together with the students. An example of a jointly developed environment model can be found at

http://hugin.hsh.no/nitol/DoODL/classroom98/PiOL/.

And an example of the virtual institution learning environment you can find at http://www.idb.hist.no/nitol

Other models of learning environments

The European Socrates project MECPOL (Models of European Collaboration and Pedagogy in Open Learning) has surveyed and developed several models of interest in this area. They may be studied through the printed publications of the project outcomes ('deliverables') [MECPOL, 1998], or may simply be downloaded from Internet, where they are listed on the MECPOL homepage, http://www.idb.hist.no/ mecpol/. Of particular interest should be the *Guidelines for networked open learning in a virtual learning institute* (Product 3), and the shorter version of *Guidelines for ODL - a Virtual Learning Institute (VLI)*.

More extensive experience in this field is available as the on-line course in *Pedagogy in Open Learning* mentioned above, and is described in a paper, *Learning by doing - an Internet course on methods for ICT based ODL* [Ask & Haugen, 1998] at the BITE conference (Maastricht, March '98).

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Distributed Information Storage and Retrieval Agents for Web Information Gathering and Recommendation*(DISRAWIGR)*

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Abstract In DISRAWIGR the classical information and storage retrieval features are distributed across the different aagents and sites where information might be stored and requested. For the retrieval so-called hybrid query and document feedback is proposed taking into account the excellent results obtained in our experimental system. For the implementation of DISRAWIGR a distributed agent platform is necessary, as it is given by the Java abstract engine.

0 Preface

On the world wide web each day a large number of information entities is added and consequently an arbitrary user exploring the net get lost soon. So called search engines have been introduced and used in the last couple of years, but even those search engines are not providing the necessary means to get structured effective access to the relevant information sources. In the following a brief discussion is given on whether and how mature information storage and retrieval techniques can be used to help both the technical expert as well as naive user to navigate through the web.

1 The Basic Information Storage and Retrieval Process Model

The task if an information gatherer on the web is to get efficiently the most precise response to an information request. In general we have to distinguish two kinds of request. The first type of request is given when an requester ask for information containers (e.g. web sites) identified by some formal descriptors, such as author of an article.When the requester is not aware of the formal descriptors (or part thereof) a content description has to be used to identify and retrieve the requested information content (e.g. description of the BeOS, What are the decision of the WTR on the R&D programmes of the GMD). In the first case the retriever has to look for the information containers that exactly match the relevant terms of the request. A semantic matching is necessary when the requester poses an informal request. The scenario for information storage and retrieval comprises several components to get hold of the information containers as well as to manage the contents. In order to make both the information containers as well as the information container contents available several features to store and retrieve them have to be provided.

Following [2], [5], [7], [10] a basic information storage and retrieval model therefore has to comprise: set I of input features i applicable to get the information into the site, set E' of entities e' in natural language, e' = <e'1, e'2, e'3, ...e'ne>, set R' of requests r' in natural language, r' = <r'1, r'2, r'3, ...r'me>, set L of terms l to be used to index the items of E' and R' (- which might be subdivided into set LE of terms le to be used to index the items within E'and a set LR of terms lr to be used to index the items within R' -), set T.1 of transformations to map E' on its internal representation leading to the set E of internal entities e in index language L (or LE), e = <e1, e2, e3, ...en>, ei are elements of L (or LE), set T.2 of transformations to map R' on its internal representation leading to the set R of internal requests r in the index language L (or LR), r = <r1, r2, r3, ...rm>, ri are elements of L (or LR), LE, LR and L are integrated into a coherent consistant thesaurus, such a thesaurus might be obtained by extending standardized index term lists (e.g. US library of Congress Term List, ACM computing review categories), search function s on the Cartesian product of E and R which defines the result of the search as a partial ordering of E, threshold function t which cuts of the non-relevant search results based on a threshold value, which indicates the lower limit of match value. Based on this components of the basic retrieval model a basic retrieval process works as follows:

1.Each entity e' and each request r' is transformed by the input features into the corresponding e and r. The e as well as the r are represented as n-ray vectors. The components of the vectors are defined as binary values (leading to Boolean storage and retrieval), numerical values (leading to linear storage and retrieval) or relevance functions (leading to functional storage and retrieval). As both Boolean and numerical values can be defined as constant functions we need only to consider the functional storage and retrieval, which we will call just information storage and retrieval or IRS for short.

2. Each request vector has to be checked against each entity vector. A correlation coefficient is computed for each pair <r,e>. Based on the comparison the entities are ranked from worst to best match. The ordinal number of the matchlist defines the rank of a particular entity with respect to a given request.

3. A threshold value is used by the threshold function to separate the relevant from the irrelevant entities. In case no threshold value is given the partial ordering resulting from the comparison is used to generate the response vector. (Remark: In order to save space and communication the entity objects as well as the requests are captured in inverted file organization IFO. In an IFO a thesaurus is enhanced by references to the names and locations where the particular thesaurus item appears).

2 Typed Agents for Information Gathering on the Web

In order to achieve an extensible and adaptable agent one needs to separate the following issues i) Agents being typed declarative or procedural procedures or programs, ii) Agent engines or Agencies providing the execution environments, iii) Intercommunication between agents defined via agent interfaces or protocols by using the services of agencies as well as, iv) Intercommunication between agent engines (or agencies), which are defined via the agent model and the agent interface model.

As a consequence an agent is to be viewed as defined by its: (e.g. Software quality and productivity model Y7), location (e.g. http:\\www.scope.gmd.de), function specification of agent service e.g. semantics), type of agent service (e.g. book, report, program), environment of agent definition and application (e.g. HotJava), store of the agent to keep information objects, interface of the actual agent to other agents.

Assuming that our information gathering scenario comprises: a set of Individuals (sometimes called users): I1, I2, ..., In, a set of Representatives of Individuals: R1, R2,....., Rn, a set of Agents A (such as A01, A02, A03,....A0k0 to be used to implement the agent engines, A11, A12, A13,....., A1k1 to be used to implement the user agents, A21, A22, A23, ..., A2k2 to be used to implement the agent interfaces, A31, A32, A33, ..., A3k3 to be used to implement the engines interfaces, ..., Ai1, Ai2, Ai3, ..., Aiki to be used to implement the agents for dedicated tasks (e.g. retrieval agents), An1, An2, An3, ... Ankn to be used to implement agent management (e.g. monitors, schedulers, etc.). An agent engine provides the operational environment for the agent enabling them to conduct their tasks or to communicate with each other. A user agent provides the storage and the features of agent that acts on behalf of a particular individual. In other words, a user agent implements the representatives of an individual.The agent interfaces define the operations and the information exchange between agents as the agent engine interfaces define those for the operational environment. A baseline for the implementation of the agent model therefore has to comprise an interaction protocol, and a minimal, extensible content language that can be used by agents or agencies to support the operation as well as the interaction. At present Java seems to be an appropriate candidate for such an agent base line. A promising approach for an agent environment might build on both agents conducting on-site information storage and retrieval and on resident agents conducting remote information storage and retrieval.

As there are no statistically valid data available on cost and benefit of each at present both approaches might be worthily to be explored. The mobile agent approach might be appropriate where huge amounts of data has to be explored whereas the resident agent approach seems to be right in case where large amounts of different types of content explorations (e.g. as in data mining) have to be conducted. Taking into account the experiences from classical information retrieval a hybrid approach interleaving the mobile and the resident agent approach might be the most effective. For this case we need to have guarded agents in the form of:

if guard then agent *or* guard p1: agent1; p2:agent3; p3:agent3; ...., pn:agnet.n draug

As the agents are used not only to define tasks or procedures but also to store information they have to have a typed storage. As a consequence an agent might be viewed as a high level named and located procedure with defined typed functionalities and typed data types for the storage. For a baseline web information gatherer one might start with a set of user agents, each representing an individual, set of dedicated tasks agents, each acting on behalf of one or more user agents, as well as a starting set of so called information brokers, which provide remotely references to the web sites to be considered in an web information gathering process.

3 On the description of Web Site Content

As in traditional library systems information entities on the web might be catalogued using standardized dictionaries and thesauri or lexica. But at the present point in time information is provided in a variety of forms on web sites. As there is no standard or norm for web sites each web site designer defines at least on web site scheme or let's say web site data structure. Even when there will be a standard (like SGML, MCF, etc.) there will be more than one metacontent schema as well as at least a couple of content schemes. On the other hand one has to respect freedom of each user in the net to use a specific scheme considered by that particular user as appropriate. Effective and efficient information gathering on the web therefore will require means to handle a couple or even all the so called metacontent schemata as well as all content schemata at the same time. This is different from classical storage and retrieval procedures on single engines, where a dedicated schema for both the meta content and the pure content is only necessary. As a consequence one needs an extensible and

enrichable agent and object description scheme. For a base system on might start with a flexible schema like the following

object := <object-type>
< object-id-type: object-id>,
object-location-type: object-location>,
object-author-type: object-author>,
object-neighborhood-type: object-neighborhood>,
object-content-type: object-content> ,
object-extra -type: object-extra >

To identify the set of relevant descriptors a standardized thesaurus has to be used, such as the one available from the US Library of Congress. In general one gets a declarative object scheme as the following:

object <- oname, olocation, ofunction, oauthor, oneighbourhood, ocontent, oextra

4 An Information Storage and Retrieval Process Model for Distributed Agents

For the realization of a web based IRS we assume to have available the following agents: user agents to handle the interaction between the user and the agent engine as well as to manage the user agent itself, task agents to conduct dedicated functionalities, such as indexing, transformations, correlations, aggregations, assessments, etc., and broker agents to keep gathered information on users, websites, tasks, and agents.

An agent based information storage and retrieval model can be defined now by the following components a set I of input agents i applicable to get the information into a site (e.g. HTML-Editor, or Navigators, Explorers), a set O' of objects o' (i.e. web sites) in object language OL', o' = <o'1, o'2, o'3, ...o'no>, a set R' of requests r' in natural language, r' = <r'1, r'2, r'3, ...r'me>, a set L of terms l to be used to index the items of O' and R'(which might be subdivided into a set LO of terms le to be used to index the items within O', a set LR of terms lr to be used to index the items within R'), a set T.1 of transformation agents to map O' on its internal representation leading to the set O of internal objects o in index language L (or LO), o = <o1, o2, o3, ...on>, oi are elements of L (or LO), a set T.2 of transformation agents to map R' on its internal representation leading to the set R of internal requests r in the index language L (or LR), r = <r1, r2, r3, ...rm>, ri are elements of L (or LR), a search function s on the Cartesian product of O and R which defines the result of the search as a partial ordering of O, a threshold function t which cuts of the non-relevant search results based on a threshold value, which indicates the lower acceptance value.Using this funtionalities the agent based information gathering works as follows:

A) The user i.e. a provider invokes an user agent to get access to the agent environment as well as to provide access to the user's store for other agents. As a result one gets:

provideragent <-
providername, providerlocation, providerfunction, providertype, providerenvironment, providerstore, providerinterface, providerextra
providerobject <-
providername, providerlocation, providerfunction, providerauthor, providerneighbourhood, providercontent, providerextra

B) Information provided by a web site is indexed by so called indexing agents which take the respective language LO or LR (or just L) as defined by a standard thesaurus. The result will look like

indexagent <-
indexername, indexerlocation, indexerfunction, indexertype, indexerenvironment, indexerstore, indexerinterface, indexerextra
indexedobject <-
indexedoname, indexedolocation, indexedofunction, indexedoauthor, indexedoneighbourhood, indexedocontent, indexedoextra

If all websites are indexed one gets the set of indexed websites

indexedwebsites <-
indexedobject1, indexedobject2, indexedobject3, ..., indexedobject.nn,
indexedagent1, indexedagent2, indexedagent3, ..., indexedagent.mm,

C) Requests posed by a user are indexed by so called request indexing agents which take the respective language LO or LR (or just L) as defined by a standard thesaurus. The result will look like

requesteragent <-
requestername, requesterlocation, requesterfunction, requestertype, requesterenvironment, requesterstore, requesterinterface, requesterextra
requestedobject <-
requestedoname, requestedolocation, requestedofunction, requestedoauthor, requestedoneighbourhood, requestedocontent, requestedoextra

If all requests are indexed one gets the set of requests
indexedrequests <-
requestedobject1, requestedobject2, requestedobject3, ..., requestedobject.ll

D) The match of the requests against the provided objects is conducted by a dedicated ***match agent*** which is parameterized to execute the following focused matches: *indexed request against indexed objects, indexed request against classed-indexed objects, classed-indexed request against classed-indexed objects, indexed request against object-classed-indexed objects, classed-indexed request against classed-indexed objects.*

The *total retrieval process* the comprises:

match agent(agent environment, requests, objects, final response) <-
totalmatch(response, objects, request),
assessment(response, final response, assessmentobjective)
totalmatch(response, objects, request) <-
mpii((response, indexedobjects, indexedrequest),
mpdcii(response, descriptorclassindexedobjects, indexedrequest),
mpdcidci(response, descriptorclassindexedobjects descriptorclassindexerequest),
mpocii(response, objectclassindexedobjects, indexedrequest),
mpocioci(response, objectclassindexedobjects, objectclassindexerequest)
or any subset thereof (i.e. any combination of the individual match processes).

5 Feedback-based Information Gathering within an Agent Environment

As the ultimate goal is to get short responsetime and a minimum usereffort one has to investigate the procedure and the response to elicit that. In order to achieve this goal one might assume the following approaches:

<> Viewpoint one (*request feedback*): *user to the universe* i.e. change of user request towards relevant objects to be found will ensure increase in recall and precision.

<> Viewpoint two (*object feedback*): *universe to the user* i.e. modification of the objects to be found towards the user's request will lead to higher recall and precision.

<> Viewpoint three (*hybrid feedback*): *universe and user towards each other* i.e. modification of user request space and objects space are intertwined.

To automate the feedback one has to make use of the request response relation. As defined above we get from an assessment of an retrieval process amongst other the following assessment measures:

objectsfoundandrelevant(response),
objectsfoundandirrelevant(response),
objectsnotfoundandrelevant(response),
objectsnotfoundandirrelevant(response)

and the aggregated measures

coverage(response), recall(response), precision(response).

The aggregated measures can't be used directly to modify request space or object space, since the aggregation functions applied are not bijective. Our goal, therefore, has to be to directly exploit the vectors representing the request space, the vectors representing the object space and the vectors representing the responses to obtain change vectors. Using the non-aggregated measures we can obtain change vectors by separating discriminating indexes from non-discriminating ones. The frequency of both then is used to change the respective vectors in the respective spaces.

6 Bookmark Repository: Storage and Retrieval of Bookmarks

In this section we discuss a typical appliation of the DISRAWIGR techniques. The bookmark domain is seletced as this is considered an attractive example from the individual users point of view. In the following we assume to have available structured bookmark list s as provided by today's web browsers or editors, i.e. we have a tree over a set of (composed) terms, each denoting a category , a phrase or just a basic term. The leafs of the tree are bookmarks, denoted by its name or identification, location, author, links to related bookmarks, description, list inclusion date and bookmark visitation date. In case we get access to a relevant number of bookmark lists one might want to integrate them in a common framework in order to exploit the knowledge represented in that set of bookmark list. As we consider it impossible to create the one and the only bookmark list we aggregate the bookmark list provided by different bookmark list managers into one bookmark repository by taking the terms used in the bookmark trees to index the individual bookmarks and insert those indexed bookmarks into an bookmark information storage and retrieval agent.

We can pose requests against the bookmark repository by using the terms used in the aggregated bookmark lists or just by using the terms to be found in the individual bookmark lists. From use of terms in the individual bookmarks we might generate weights for the terms in the aggregated bookmark repository, which can be viewed as a set of bookmarks, where each term appearing in the description of a particular bookmark gets a dedicated weight. A bookmark requester might use the aggregated set of terms or only those terms used in a particular bookmark list to query the repository.

There are several benefits for the owner of a bookmark list to be involved in the bookmark repository. The first is to be able to reflect a personalized bookmark list with respect to an aggregated set of qualified bookmarks provided by the repository. The most attractive return might be that the bookmark lists of each participating bookmark list manager is to be enhanced by bookmarks obtained by the aggregation. This will allow to update the bookmark list upon request, in defined intervals or continuously.

The bookmark updating service works as follows. Conducting a match of bookmarks of a bookmark list with the set of bookmarks in the repository by our vecfieldvecfieldmatch procedure one gets the set of relevant bookmarks by picking those with match with respect to a defined threshold, which is in our case an element of [0,1]. The bookmark repository provides means to aggregate arbitrary tree-structured bookmark list into the vector model for bookmark storage and retrieval. In employs the frequency of terms to weight the terms used to describe the bookmarks. In this respect the repository in a way filters individual bookmarks into a coherent network of bookmarks. The aggregated views are used to update the bookmark list at the individual bookmark authors site.

7 Conclusions

DISRAWIGR provides a model for distributing the storage and retrieval functionalities across internet clients and servers by introducing the agent concept. An agent in this context is much more than a sequential or parallel procedure or a distributed object system. The agents are communicating across internet sites, thus making it unnecessary to load the internet with all the sites to be transferred to and back to search engines or data bases. In this concept the actually required information is transferred at the end of the process. During the retrieval process

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The WWW based course feedback system at Tampere University of Technology

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1. Introduction

The aim of the study was to develop a WWW based course feedback system that covers all the about 800 courses at Tampere University of Technology (TUT) serving both university students and teachers. The basis for the new web system was an existing UNIX based program which is daily used by the students.

2. Development of the system

The new feedback system includes generation and analysis of course feedback pages, giving course feedback and summary of course feedback. Course feedback pages include different questions; general questions (the same for all courses), free feedback, and teacher's questions, which the teacher can choose from the question list or make his own questions. The teacher needs a password for this function. Teachers can also study the given feedback of their own courses and analyze the gathered information. In the second part students give feedback for selected courses. The third part (summary of course feedback) is meant for common use. All willing persons can study the summary of all course feedback of different departments. Information about course feedback from all students is automatically collected. The system consists of 1034 files (46 Perl files and 988 html files).

3. Testing of the system

In the first step, the feedback system was tested by the programmers. In November 1997, all institutes were delivered their own userIDs, passwords and instructions for the system. After that the interested institutes could test the system. Teachers have created customized feedback pages to about 20 % of courses. Generally the system has been working well. The system has not collapsed even once. Students have given feedback since December 1997. No special publicity campaign in which students would have been encouraged to use the system has been carried out. The old Unix based program is still used at the university, and the new system is used besides it. The feedback in the system was asked by e-mail. By the end of May 1998, the administrators of the system have received 23 comments about the system by e-mail.

The comments gave many new ideas. The benefit of the system is that everybody can easily use the WWW system, and the answers are anonymous. The feedback system also helps to improve the quality of education. The drawback of the system is that the same user can give feedback more than once for the same course because currently the system is open to everybody. In the further development after the testing it may be necessary to move the system to Intranet and use some encouragement methods for students.

4. Conclusion

In this project a new course feedback system in the Internet has been developed and tested successfully. The study shows that it is possible to create this type of a web system using Perl. Based on the testing results there is some need to improve the system. Students can somehow be encouraged to give feedback about the courses. Then the number of answers will increase and the statistical reliability of the system improves. So far the experiences from the system are so good that the use and development of the system will be continued.

An English demo version of the system is available at http://fbs.ee.tut.fi/demo.
Test version (in Finnish) is available at http://fbs.ee.tut.fi/palaute .

Bleeding on the Edge:
Experiences from Teaching a Multimedia-Rich Course over the Internet

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Abstract
A recent master's level course pushed the envelope on using instructional Internet technologies. This course utilized several in-person sessions (both on- and off-campus), extensive use of e-mail, and a dedicated web site. The majority of classes were held over the Internet using CU-SeeMe client and server software. Certain experiences (e.g., installing and configuring new software, training students to use the software, and back-up methods of instruction) were anticipated, while others had to be dealt with on the fly (e.g., incompatible hardware, Internet propagation delays, and synchronizing audio and video). Instructors contemplating this mode of content delivery need to be aware of the benefits and the costs, especially in terms of time for instructor and student training, multiple modality and error-alternative preparation, and practice.

Background

The Department of Educational Administration and Foundations, a graduate-level unit of the College of Education at Illinois State University, has as one of its primary missions the preparation of educational leaders in public schools. Accomplishing this mission often requires teaching courses off campus. One off-campus cohort draws students from a school district located in the town of Wheeling, Illinois, approximately three and one-half hours drive from campus. The distance from campus made weekly travel impractical. Intensive, multi-day weekend sessions were examined although some courses do not adapt well to this delivery format. Dedicated-line compressed video is a popular alternative, except that the district did not have the facilities for a remote site connection. Neither were facilities available for delivery via satellite. Asynchronous Internet-based (web) instruction has been used in other subject areas, although there was some concern about teaching a master's level, research and statistics class solely asynchronously. Compressed two-way audio and video over the Internet had been used experimentally, but never as a primary means of delivering instruction. *Could this new technology be used for primary instruction for this off-campus group?*

By mid-summer of 1997 the necessary software (Cu-SeeMe version 3 and Reflector version 2.1) were purchased and installed at both the University and on three computers at the school district. The Instructor's computer was a Dell XPS/H266, and Pentium-II class computer with a 266Mhz processor, 64Mb of memory, a 21" monitor with 4Mb of video RAM, and a high-speed token rink connection to the Internet running under Windows 95. A Panasonic Egg-Cam was used to capture the live video and audio, while a sound card built into the computer provided audio to the stereo speakers. The reflector software as run on a Dell XPS/H233 machine, a Pentium-II class computer with a 233Mhz processor, 64 Mhz of memory, a standard monitor with 2Mb of video RAM, and a high-speed token ring connection running Windows NT version 4. Three computers were purchased for the district – all were Hewlett-Packard Vectra machines; however, these machines proved incompatible with the then-available Panasonic Egg-Cam and had to be replaced with functional clone computers. These machines were Pentium 133Mhz computers with 32Mb of RAM and 15" SVGA monitors, each having an audio board, speakers, and Panasonic Egg-Cam.

The first task facing the instructor was the setup, installation, and testing of the various hardware and software components. Different transmit and receive bandwidths, audio and video codecs, and connections strategies were

experimented with over the course of almost two months of trials. During the same time the instructor was reformatting courseware for this new model of delivery. To facilitate the evaluation of this course the instructor kept a daily diary, recording his observations and experiences. Students were encouraged to e-mail the instructor detailing their impressions, as were the technical staff assisting with the project. These written records, along with the materials developed for and used in the course, were examined as the record of the course activities.

Results

The class began in mid-August of 1997 with two days of on-campus orientation sessions. During this time students were introduced to the technology of CU-SeeMe, along with a review of basic computer operations and WWW/e-mail over the Internet. Students also received the first six hours of content instruction in the research and statistics course. Three weeks later the first class over the Internet using CU-SeeMe was held. Technical problems with the Hewlett-Packard computers prevented the students from utilizing all three computers, with the result that all of students had to crowd around a single screen. A projection system was hastily put together, although the degree of class interaction initially suffered since the instructor was unable to see or hear all of the students in the class. When the HP machines were later replaced with other, compatible computers this problem went away, and later sessions were able to utilize all three student computers (with three to four students sharing a computer) running simultaneously.

Start-up problems continued to abound, however. Early sessions were plagued with difficulties in transmitting audio, and many times the back-up system of a speaker telephone (and long-distance call) had to fill in for the non-transmitting audio (even though this put the audio badly out of sync with the video). While several computers could be placed in one room to receive and send video, out-of-sync audio necessitated that only one machine be used for sending or receiving audio. During one class the server crashed, resulting in a 15 minute break while the server was rebooted and the reflector software reinitialized. Another session had to be canceled entirely when an MCI telephone switching node, located between the campus and school district, was experiencing difficulties and holding packets in excess of 400 milliseconds. [NOTE: while this might not sound like a long time it dramatically degraded the audio and video transmissions to the point where neither was intelligible.] One session was ended early when the Whiteboard application, which had been running perfectly for almost two hours, crashed right before the final example was to be completed.

By the end of the fourth month operations were running relatively smoothly. Reliable connections could be established between the university and the school district, and audio and video were configured to allow reasonable communications under almost every network circumstance. Although minor software glitches continued to occasionally crash programs (or disconnect computers from the conference) the instructor and students had learned to take these problems in stride, rebooting the computer and/or application or reconnecting the computer with only minimal downtime. The simultaneous chat window proved to be quite useful, with students able to ask questions of the instructor without interrupting the flow of a lecture or discussion. To manage the instructor had to learn to respond (by typing or in voice) to these queries while continuing with a simultaneous audio and video presentation! It was observed that chat was used as frequently for content related needs (e.g., "what was the web address again", or "could you give us an example of what you just said") as for non-content related needs (e.g., "the audio is too low", or "I will miss class next week").

Conclusions

1. *Both instructors and students need a lot of time to become familiar and comfortable with the technology – hardware and software – used in this kind of distance education.* The initial orientation session was critical, although we found that additional time still needed to be spent throughout the course to refresh and expand knowledge.
2. *Instructors need to plan for the unexpected, and have alternative and backup methods for delivering course content in the event of a failure of the primary method.* The speakerphone provided an instant link between the university and the district, critical at the start of each session and when technical glitches severed the connection. Having additional session dates and times written into the syllabus, as well as alternative modes of information presentation (whether over a web site or in person) provided flexibility not normally found in the typical college class.

3. *Instructors need to create multiple and repetitive modes of content delivery.* We discovered, for example, that CU-SeeMe was not an appropriate vehicle for delivering videotaped presentations. While the program could handle this type of input it would often fail to keep audio and video synchronized. Rather than deliver videos using CU-SeeMe it was decided to encode the videos for streaming presentation from the web site. Real Media's video encoder and plug-ins for Netscape and Internet Explorer provided a more reliable means of video presentation to the remote class. Likewise, content shown on the Whiteboard was mirrored (using PowerPoint shows) on the web site, providing students a secondary means of viewing this content and protecting against unexpected program or system failure during class.
4. *Finally, the current state of this technology requires that potential instructors and students be relatively technically savvy as well as highly fault tolerant.* The emergent nature of these new technologies, together with the unpredictability of the Internet (and, in some cases, the unexpected failure of software components) will require a need for the instructor to be able to think and act relatively quickly. Although not yet mature enough, in our opinion, to be relied upon as the sole means of distance education instruction, Internet-based audio and video conferencing can fill a developing niche for off-campus student needs.

An Integrated Methodology for Designing Web Applications

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Abstract: This paper describes a system for the design and implementation of distributed Web applications. A distributed framework to access and update databases based on the Java serialization and Java beans frameworks is explained. Java Beans are used to compose light weight applets that interact with such a database.
The objective was to have a truly flexible way of implementing distributed database or knowledge base systems, making maximal use of automatic code generation and component technology.
The broad outline of the system is as follows:

- A CAD tool is used to design a domain model, with constraints and queries.
- The tool's output is used to generate (a) a (relational) database and (b) Java classes implementing the model.
- A generic client and server can communicate the objects across the network using the built-in Java serialization mechanism.
- An extendible Java beans framework is used to compose client applications to query, insert and update objects.

1. Introduction

The appearance of the Web, and more recently of Java applets and JDBC have made it a lot easier to develop distributed information systems. The problem with using JDBC to access remote databases through the web is however that it tends to create two-tier client-server systems. The main problem of the two-tier approach is that the client application code is riddled with references to fields and tables of the database, making the code difficult to maintain and debug, especially when the database is modified later. The result usually is that, when the database is changed, all client applications have to be completely re-written.
A better, but more complicated method is to use a three- or multi-tiered architecture. In a three-tiered application, the client communicates with the server not in terms of SQL, but in terms of the objects and classes. This usually leads to a system that is a lot easier to evolve, because any incompatibilities in the client applications are detected by the compiler.
The problem is that developing a three-tiered application requires a lot of expertise and effort from the developer. This is because the different technologies used: a relational database, a programming language and a network protocol like web forms do not integrate well.
We have tried to create a system than encapsulates most of the complexities of three-tier application development, and in which a single object oriented paradigm is used for all of the layers.
In the remainder of this paper, we describe the model and system which we have used to implement distributed database applications. This includes:

- an object model known as EROOS;
- mapping rules to automatically map the EROOS schema to a (relational) database implementation;
- coding rules to automatically map the EROOS schema to Java classes and interfaces;
- a generic server that instantiates objects from the database and stores new and modified objects;

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- Java beans for visualizing, editing, querying and creating objects, that can be used to compose client applications.

2. The EROOS Object Model

Figure 1 shows an example of an EROOS schema [Steegmans 95]. Notable difference with other object models are :

1. Relationships are modeled by separate relationship classes, or by relationships embedded in a class.
2. Attributes are of a simple atomic domain. Lists have to be modeled by a separate class.
3. Attributes and relationships can be immutable. Mutability is indicated with a curly line. E.g. a person's name or birth date can not change, his salary can.
4. Relationship classes (indicated with a small circle in the center) can relate to at most two other classes.

These limitations are mainly meant to limit the number of ways in which a particular situation can be modeled. Generic object models usually allow many equivalent models for a given domain, which is why many people find object modeling difficult.
We use EROOS to define a domain model that excludes any transactions or user interface specifics.

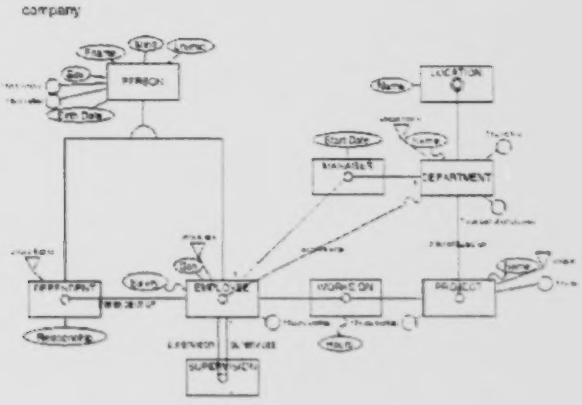

Figure 1: EROOS model of the *company* database

3. Mapping Objects to a Relational Database

To implement the schema on a relational database, we have to devise a mapping of object classes to tables. To do this a few decisions have to be made. We need to (1) implement object identity (2) map names of classes and attributes, (3) map inheritance relationships and (4) enforce the implicit constraints of the model.

3.1. Object identity

The fact that traditional relational theory does not recognize object identity is a major obstacle to a more object oriented perspective to database design. This deficiency illustrates the data-driven nature of relational database design. One might suggest to use a key attribute as an object identifier, but this will not do for the following reasons:

- Some entities or classes may not have unique attributes, but the objects do have an identity (e.g. dependents in Figure 1). Normal practice is to include a copy of the key of a related entity and use a composite key. This introduces more maintenance problems, as the keys must be kept consistent.
- Keys with a business meaning introduce inflexibility, because over time, business meanings change. Keys with business meaning create dependencies in other tables or classes.
- Attributes usually can change value, but the identity of an object may never change.

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So the object identity should be implemented by a artificial field with unique values, generated by the database. Because database administrators do not like artificial keys, we must be careful when deciding on naming and values of these artificial keys, and be consistent. It is best to use a key that is globally unique, but from which the object's class can be derived.

3.2. Naming

We use simple rules to map class names and attribute names to table names and field names that avoid problems such as name collision and reserved words.

- Each model or subsystem has its own name, and this name is prefixed to all class names to form table and view names.
- An attribute's name is prefixed with the name of the class declaring it to form a field name.
- Relationships are given the name of the relationship alias if there is one, or the name of the class referred to, prefixed with the name of the class defining the relationship.

Using a strict naming scheme will make it possible for developers to automatically map attributes to fields, and moreover, it allows automatic code generation for interaction with the database.
We also distinguish between a physical and logical storage at the database level. Logically some classes are represented by views that join a number of subclasses. Physically only non-abstract classes are stored in tables.

3.3. Class Hierarchies

A class can be mapped to a relational table, with a field for each attribute of the class. For inherited attributes there are two possible solutions, generally referred to as horizontal and vertical mapping.

a) Vertical mapping means that the declared attributes and the inherited attributes are stored in separate tables. Each class is mapped to a table containing only the attributes declared in that class. A great advantage of this approach is that a change to a class only means changing one table. Another advantage is that existence dependency constraints can readily be implemented as foreign keys in the database, even for relationships that refer to an abstract class. A serious disadvantages is that it becomes difficult to insert and update objects manually through SQL.
b) In horizontal mapping both the declared and inherited attributes are stored in one table. This means that an object is stored in exactly one table, so insertion and retrieval can be done relatively quickly. We don't need a table for an abstract class, but a view that joins the specializing class tables or views. A disadvantage is that if one class changes, all the tables for its specializing classes have to be changed, which would lead to inflexibility. As our objective is to automatically generate the table definitions and code from a formal schema description, this disadvantage largely disappears. Therefor, and because this mapping generates tables that are easy to manipulate manually, we choose to use this mapping.

We do however need a safe solution for existence dependency of abstract classes. To provide this, we will create a table for each abstract class that will contain only the identifiers of the objects of the derived classes. It is updated by insert and delete triggers on the derived class tables. Integrity is maintained by assigning the foreign key constraint to that table.

3.4. Enforcing Constraints

The first and foremost constraint to enforce is the uniqueness of identifiers. This can be done by requiring that identifiers are unique within each table and requiring that the identifiers within the class map to the actual class.
The immutability of attributes and identifiers can be enforced by disallowing updates of the identifier field in update triggers. Alternatively the update privilege can only be granted to a view that contains only the mutable attributes. Existence dependency constraints are implemented by referential constraints. This means that when an object that is reference by other objects is deleted, either an exception is raised, or the referring objects are deleted also.
It is very important to make sure that as many as possible implicit and explicit constraints are enforced by the underlying database itself, because otherwise inconsistency will sooner or later begin to creep in. For many

manipulations it will be convenient to use SQL scripts instead of using some other programming language. This is where thinking or programming errors will create inconsistent data. If constraints are enforced by the database itself, these errors will not easily go by unnoticed.

4. Generation of Java Domain Classes

Instead of writing client applications using a database protocol like ODBC or a proprietary database protocol, we will write them in terms of classes generated from our domain model. This is very important for reasons of flexibility:

- Client application writers need not concern themselves with the technical details of the database mapping or database protocol. The client applications are effectively independent of the mapping and protocol.
- Subsequent changes in the model and database are easily located in the domain model classes, and adapting the client application is straightforward. The compiler will detect most of the inconsistencies.
- Multimedia data types such as images can be mapped to the database independently of the client application.

In principle any object oriented programming language can be used, but as it turns out, Java is particularly suited for the described approach.

4.1. Interfaces

For each class in our model we generate an interface with the same generalization/specialization hierarchy of the model. For each attribute a selector method is declared, and for each mutable attribute a mutator method is declared. For relationships a method is declared that simply returns the related object. For inverse relationships at the many-side, a method is declared that returns an enumeration of related objects.

4.2. Domains

The domain names used in the EROOS schema are mapped to a RDBMS domain and a Java domain. The database access layer must have a method to convert the Java domain to the RDBMS and vice versa. If our database access layer has a method getImage() to get an image from a database field, we can use image as an attribute in our Java domain classes.

4.3. Classes

For each domain interface we generate a Java class that implements it. Delegation is used to implement multiple inheritance.

Each class only has private data members. All access has to go through the selector and mutator methods. Object identifiers are implemented by a class representing the identifier. The only public constructor will create a new identifier. The serialization engine creates the existing identifiers from the database and makes sure that within the same run-time environment no two identity objects exist that represent the same object.

Relationships are represented by the identity of the related object. Inverse relationships (many side) are represented by a list of identity objects. These lists are kept up to date by the constructors and destructors of the related objects.

It is also the responsibility of the Identity class to retrieve the remote object from the database and cache a reference to it. We have used a so called soft-reference implementation (Java runtime class 'sun.misc.Ref') for this, which allows caching constrained by the garbage collector.

Each class has a public constructor that takes the immutable attributes to create a new object. There is also a package protected constructor that also takes an identity object parameter. This constructor is called within other constructors when a member for delegation is created.

Relationships are passed to the constructor by passing the related object. The constructor then has to call a method in the related object to update the inverse relationship.

4.3.1. Queries and Constraints

Certain queries and constraints expressed in the model are implemented in the Java code level. Queries that return a list of objects that can be expressed as a SQL query are implemented by a Java method returning an enumeration of objects.

Constraints that can be expressed in Java can be implemented as selector methods that are checked in constructors and mutators. If a constraint is broken, either an exception is thrown, or a designated event is called to recover.

4.3.2. Functionality

It is essential that the generated code is never modified, because these modifications may hinder the evolution of the system later. Therefor, when specific functionality is to be added that could not be generated from the model, it should be implemented in a class that extends the domain model class. The serialization layer can be configured to use the derived class instead of the original class. It is even possible to let the client application do this configuration at run-time, so that different clients can use different versions of classes with different functionality. This also allows the implementation of what has been called 'application facades' [Fowler 97], classes that further encapsulate the behavior of the underlying domain model classes for the benefit of specific applications.
There is one instance in which it may be useful to modify the generated class, and that is to remove unneeded reverse relationships. Computing the inverse relationships from the database can be relatively expensive. The serialization layer is implemented so that it will not attempt to reconstruct inverse relationships if they are not declared in the Java class.

5. Java Beans Framework

Java Beans [Sun 97] are a promising new technology for visual programming environments for Java. A Java Bean is a Java class that is implemented according to a specific pattern regarding :

- The naming and signature of selector and mutator member functions.
- The use of a specific event model to communicate with other Java bean objects.

A Java beans enabled programming environment allows a programmer to drag Java bean objects onto a canvas, and manipulate them without programming. Event paths are drawn from one bean to another, allowing the beans to interact.. An interesting and important feature of Java beans programming is that is allows that programmer to design a program while it is running.
A Java bean is highly reusable component. It is written once and used in many applications. Java's object serialization [Sun 96] and introspection make Java beans frameworks more flexible and simpler to implement.

5.1. Basic Beans

Basic generic beans are display/edit fields containing a number, text, a date or a time value. A date can be represented by text, or by a visual representation of a calendar or clock. A number can be displayed as text, or by a dial or slider. We intend to include Beans that allow formatted (HTML) text and images to be displayed and edited. Other media type handlers such as (streamed) audio and video, speech etc. will be included as new media API's become available for Java.
These basic objects represent one member field of a domain model object. The view objects use Java introspection to access the proper methods to get and set the target field, so they can be written independently of the domain model classes.
Other beans are used to display a list of objects that are retrieved from an inverse relationship or a query.

5.2. Bean Dialogs

A number of basic beans are assembled on a bean panel. A bean panel can be used in four different ways:

- To display a domain object.
- To edit one or more of an objects' fields, or delete the object altogether.
- To create a new object.
- To select an object from a list.

Note that in our object model, the creation of a reference between object is encapsulated within the constructor of a relationship class, so all possible interactions are combinations of these four.

6. Web Access

We have also created a Web Servlet that can be used in conjunction with a World Wide Web server to visualize objects in HTML pages. To do this, the XML-Data [XML Data] specification is used to convert Java objects to an XML file. This XML file contains part of the object graph in a computer readable form. This XML file is then converted to HTML (or another human-readable form) either by the client or the server using a style sheet mechanism. The style sheet used is determined by the client (e.g. by the language) allowing some user-specific formatting of the information.
This allows us to implement large well-structured information webs that are easier to maintain [Hendrikx 97][Elen 95].
This approach is similar to other approaches using databases and e.g. SQL to generate and maintain web pages [NewSome 97] [Houben 97][Microsoft 96]. We do however believe that our current approach allows better integration with applet technology.

7. Conclusion and Future Work

We have developed a design method supported by automatic generation of a relational database definition and Java client application code that can be used to create client-server information systems with no or little programming. The information is served either by dynamic generation of HTML pages, or by Java applets graphically composed using a number of generic Java Beans.
We are currently developing a generic XML viewer that uses the Java Activation Framework [Sun 97] to register Java beans that perform operations on data elements at different levels of granularity. This will allow a user to view and edit any XML file regardless of its data type.
We are also working on an object oriented persistence layer on top the relational database that will allow faster access, while still having the benefit of ad-hoc querying and data independence.

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Specification of Distributed Multimedia Applications in the MUSE Environment: QoS and Adaptation Issues

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Abstract: An important element of network support for distributed multimedia applications is the supplying of quality of service. In this paper we present the definition of quality of service at user and application levels in MUSE (interactive networked MUltimedia applications Specification Environment). The behavior of the application during execution is also described, as well as a strategy that allows the adaptation of the application to adverse situations in the network.

1. Introduction

Quality of Service (QoS) is an important aspect of the support for multimedia applications; however, the diversity of these applications difficults the establishment of a QoS standard. Besides, adaptation methods need to be defined to handle quality variations. This paper presents the definition of QoS and adaptation in the MUSE specification environment.

The user usually does not have conditions to specify low level parameters, like bandwidth, or even characteristics of the media objects, such as an audio sampling rate. Therefore, the system must offer an abstraction level so that users can define what they consider acceptable. Besides, the properties of a media object are not enough to define its quality. The purpose of the application is also important, or more specifically, the 3context in which the media object is inserted. For example, any noise, like that of an airplane landing, can be considered excellent even if it has been recorded in conditions that would be bad for speech.

The quality level may change for several reasons, even in networks that supply QoS, like ATM or Internet with reservation protocols (RSVP, etc.). Problems may happen in a node, deallocating the resources that an application had been using, and they may not be available in a new route or may not be reserved due to a matter of priority [Gecsei 1997]. In an environment like the Internet, however, one cannot even obtain QoS guarantees from the network, nor that the end systems have the same capacities. This leads to the creation of adaptive applications. Multimedia applications are particularly appropriated for adaptation, since media objects can be presented in several ways, adjusting factors like delay and throughput. A video, for example, can have its frame presentation rate, resolution or number of colors decreased without the quality loss exceeding acceptable limits.

2. The MUSE Environment

In the MUSE environment (Figure 1), the author defines the way media objects should be presented in terms of order, synchronization, position and quality, creating a specification that is later interpreted and presented to the end user [Gaspary 1998]. The user cannot define the quality with which each media object should be shown, since he does not know the presentation's content. The author, however, knows which information is more important and therefore should have a higher quality. Thus, the end user may take advantage of the QoS suggested by the author.

In order to avoid the author's need to work constantly with a series of parameters, the program works with QoS levels, going from Very Good to Bad depending on the perceived quality loss. For instance, an audio recorded at 44 kHz with 16 bits of sample and two channels is considered very good. This information is kept on mapping tables, which the author can customize. It is possible to create templates, allowing to specification of the most appropriate QoS for the author's purposes.

The author can also specify alternative media objects that will be used if the main ones cannot be presented. For example, a video can be substituted by an image or by another video, recorded with lower quality. These secondary media objects offer an alternative when the network does not have enough resources (e.g., slow connection), and also when the end system lacks a device necessary to present the primary media object (e.g., absence of a sound card). At run-time, it is verified if there are enough resources for the presentation, based on the media objects' characteristics and on the network's condition. The aforementioned audio would require 172 kb/s of bandwidth, for instance.

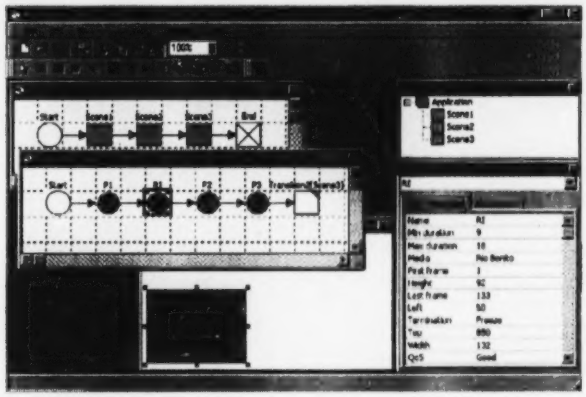

Figure 1: Interface of the authoring environment

3. Conclusions

The MUSE environment allows the author of the application to specify the presentation quality of each media object. The media object's content properties are used for the automatic calculation of presentation parameters. Because the specification of QoS is done in a flexible way, each user's preferences are taken into consideration and applications aimed to several purposes can be created. The author can define alternative media objects that are used when the main ones cannot be presented. This allows the application to adapt itself to environments with different capabilities and to fluctuations in the QoS level.

Tests are being performed in order to verify if the users can specify their applications properly and obtain the desired results during the presentation. Future works include studies of environments like ATM, and consequent changes in the module that guarantees QoS during the execution of the multimedia application.

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A Longitudinal Study of the Integration of Technology into Economics and Teacher Education University Curricula: Economics Counts

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Abstract: This paper compares the integration of technology into two university curricula at the same institution over a three-year period. By year three in both fields, undergraduate students were 100% technologically literate. However there were differences at the graduate level in Economics and Education. Generally computer literacy at this level was effected by ready access to a personal computer either in the workplace or at home.

1. Introduction and Background

This paper compares the integration of technology into two university curricula at the same institution over a three-year period. Both instructors teach undergraduate and graduate students in a public university serving commuter students from approximately a 50-mile radius. The authors believed that technology could support many of the cooperative learning activities used in their classes and was a significant way to minimize some of the problems associated with students finding time and more effective of ways working together. Also we understood that cooperative learning would allow those students who were more proficient in the use of technology to instruct their less technologically proficient peers.

2. Findings and Conclusion

Having access to online computers has been and continues to be a significant factor in determining the effectiveness of our efforts. Initially we found that campus computer laboratories were crucial in our work with undergraduate students who generally spent more time on campus than did our graduate students who as part-time students only came to campus for evening classes. Undergraduate Economics students were initially more familiar with computers than Education students. Because of this in the first two years a decreasing amount of class time was spent in the Education classes introducing students to computers. This included actual instruction in the use of email and the WWW in order to utilize course WebPages to complete assignments. However by year three such instruction was no longer necessary as all undergraduate students had the technological competency to effectively utilize course materials, which in some cases were totally online. We attribute this development to student exposure to email and the WWW in earlier classes and required courses for computer literacy in both Economics and Education. By year three in both fields, our undergraduate students came to our classes 100% technologically literate.

However at the graduate level we continue to find a very different and problematic picture. The graduate class in Economics is required for students in the MBA program. These students are generally employed full-time in area businesses. As a result, over all three years most of these students used personal computers in the workplace. They used email and had at least some experience with the WWW. These students responded well to having all course materials and assignments totally available online. Since there were frequently occasions when they would be out-of-town on business, such access allowed them to continue and even participate through the use of technology.

Our biggest concern is the continuing lack of technological literacy among graduate Education students. The majority of students enrolled in Education master's degree programs are full-time teachers whose undergraduate degrees predate any technological literacy requirements. They are a distinctly bi-polar group who can be distinguished by whether they have a home computer or not since for the most part few, if any, have convenient access to computers in their schools. Those with home computers generally have WWW access and regularly use email. Instruction still needed for these students is very specifically focused on accessing educational research materials via the web.

The other larger group of graduate Education students are those with no home computers. These are practicing teachers who, for the most part, have never owned a home computer, have never seen an email, or know what the WWW looks like. Despite all course materials being available electronically, some of these students prefer to walk to the library and pay to photocopy materials rather than learn to access them electronically. We have recommend technological literacy requirements for all of our graduate Education programs in order to begin to remedy this situation. This is a serious concern for school districts as well since we are finding that about 2/3rds of our graduate Education majors fall into this category. This is the majority of the people in the field in our geographic area. We would highly recommend that the computers in school computer labs be distributed to any interested teachers over summer vacations in order to give them the time to become familiar with computers. Teachers need to overcome some of the technological fears we see in order for them to be willing to make, which for them is a significant investment, the purchase of their first home computers. Only then will we begin to see the full integration of technology in the public school curriculum.

Building Flexible and Extensible Web Applications with Lua

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Abstract: The World Wide Web is in constant renovation, with new technologies emerging every day. Most of these technologies are still incipient, and there are few de facto standards for this "new Web". There is a need for tools that can run with current standard support, but which are flexible and extensible enough to be eventually ported to new APIs and to incorporate new technologies. On the other hand, many Web developers cannot keep pace with the fast track of Web technologies. Therefore, it is important for new tools to be simple enough to be mastered quickly by the average programmer. This paper presents CGILua, a Web development tool that matches these requirements. The paper also discusses why this tool is being adopted in many commercial and academic projects, focusing on issues such as flexibility, extensibility, simplicity, and portability.

1. Introduction

The World Wide Web has gone through a big change from its initial goal. The electronic publication of static documents, read-only and file-based is being replaced by a more complex environment, where dynamic and interactive pages are produced by components of a distributed system. In this setting, some of its adopted technologies cannot satisfy the new requirements, driving the search for many alternative technologies.

Unfortunately, embracing any new technology at this time may be premature, since there are no de facto standards for this "new Web". It is well recognized that the Web standards are key factors in its success [Hadj. 97]. Currently, many new proposals are tied to a specific vendor or operating system, compromising the openness that allowed the Web to grow explosively. Another problem is the lack of robustness, since many of the technologies are quite new, and they often have incompatibilities with different versions of hardware, operating systems, HTTP servers and browsers [Hadj 97][Everitt 96][Duan 96].

Finally, as noticed by [Everitt 96] and [Lazar 96], Web applications are frequently written by casual programmers, following a rapid prototyping approach. To tie new technologies to the knowledge of complex languages such as Perl, C++ or even Java may put a heavy load on these programmers.

Considering all these aspects, three points emerge as requirements for a Web site development tool:

1. Suitability to work based on common Web standards (like CGI [CGI 96]), being portable to different platforms and servers.
2. Openness to incorporate new technologies, in a gradual way.
3. Flexibility to accommodate different uses, from the "quick and dirty" approach of casual programmers, to an object-oriented structured approach of a skilled team.

CGILua is a Web development tool based on CGI and the extension language Lua ([Ieru. 96] [Figueiredo 96]). Although based on an "old" technology (CGI scripts), it differs from other tools by its set of features:

- a flexible and simple scripting language (Lua);
- the ability to mix different paradigms (templates and programming);
- and an extensibility mechanism to dynamically load libraries written both in Lua and in C/C++.

This set of caracteristics makes CGILua unusually portable, flexible, and extensible, while being simple to use.

2. The Extension Language Lua

Lua is a general purpose extension language that arose from our group's need to use a single extension language to customize industrial applications [Ieru. 96][Figueiredo 96]. Currently, Lua is being used in more than a hundred products and prototypes, in many academic institutions and companies. The whole package is written in ANSI C, and compiles without modifications in all platforms that have an ANSI C compiler (DOS, Windows 3.1-95-NT, Next, Solaris, Mac, Linux, OS/2, etc).

Lua integrates in its design data-description facilities, reflexive facilities, and familiar imperative constructs. On the "traditional" side, Lua is a procedural language with a Pascal-like syntax, usual control structures (*whiles*, *ifs*, etc.), function definitions with parameters and local variables, and the like. On the less traditional side, Lua provides functions as first order values, and dynamically created associative arrays (called *tables* in Lua) as a single, unifying data-structuring mechanism.

There is no notion of a "main" program in Lua; being an embedded language, it only works embedded in a host client. Lua is provided as a library of C functions to be linked to host applications. The host can invoke functions in the library to execute a piece of code in Lua, write and read Lua variables, and register C functions to be called by Lua code. Moreover, *fallbacks* can be specified to be called whenever Lua does not know how to proceed. In this way, Lua can be augmented to cope with rather different domains, thus creating customized programming languages sharing a single syntactical framework [Beckman 91].

Functions in Lua are *first class* values. A function definition creates a value of type `function`, and assigns this value to a global variable. Like any other value, function values can be stored in variables, passed as arguments to other functions, or returned as results. This feature greatly simplifies the implementation of object-oriented facilities. A more complete treatment of Lua's object oriented facilities may be found in [Ieru. 96].

Lua is dynamically typed. Variables can handle values of any type. Whenever an operation is performed, it checks the correctness of its argument types. Besides the basic types `number` (floats) and `string`, and the type `function`, Lua provides three other data types: `nil`, with a single value, also called `nil`, whose main property is to be different from any other value; `userdata`, that is provided to allow arbitrary host data (typically C pointers) to be stored in Lua variables; and `table`.

The type `table` implements associative arrays, that is, arrays that can be indexed not only by integers, but by strings, reals, tables, and function values. Associative arrays are a powerful language construct; many algorithms are simplified to the point of triviality because the required data structures and algorithms for searching them are implicitly provided by the language [Bentley 88]. Most typical data containers, like ordinary arrays, sets, bags, and symbol tables, can be directly implemented by tables. Tables can also implement records by simply using field names as indices. Lua supports this representation by providing `a.name` as syntactic sugar for `a["name"]`.

Unlike other languages that implement associative arrays, such as AWK [Aho 88], Tcl [Ousterhout 94], and Perl [Wall 96], tables in Lua are not bound to a variable name; instead, they are dynamically created objects that can be manipulated much like pointers in conventional languages. The disadvantage of this choice is that a table must be explicitly created before used. The advantage is that tables can freely refer to other tables, and therefore have expressive power to model recursive data types, and to create generic graph structures, possibly with cycles.

3. CGILua overview

The simplest form of a CGILua script is as a Lua program; when the page is accessed, the program is ran and its output is interpreted as the final HTML page sent to the browser. The majority of CGI scripts are written this way, as with Perl [Stein 97], Tcl [Libes 96], C [Weber 96], Python [Vanaken 97] etc. In CGILua, these programs are written in Lua.

The main advantage of writing a script as a program is its flexibility. The full power of the language is available in the creation of a page. This includes all abstraction facilities of a programming language, plus pre-defined functions for pattern-matching and the like. Also, some programmers find it convenient because they can still use a conventional programming style. Nevertheless, this approach is quite difficult for non-programmers, and even for programmers it is not very effective, since it operates in a very low abstraction level.

An alternative, and more interesting, way to write CGILua scripts is to use an HTML template of the document to be generated. When the page is accessed, the template feeds a pre-processor that creates the final page. These templates use special marks to indicate fields to be handled by the preprocessor. CGILua supports three kinds of fields: *Statement* fields, *expression* fields, and *control* fields. Statement fields contain Lua statements to be executed by the preprocessor; they generate no implicit output, although they can explicitly write anything to the final page. Such fields are written between the marks `<!--$$` and `$$-->`. Expression fields contain Lua expressions, which are evaluated by the preprocessor, with the result used as the final text of the field. Such fields are written between the marks `$|` and `|$`. Finally, control fields indicate parts of the document to be repeated or conditionally inserted.

It is interesting to notice that all marks have been carefully chosen so that a template has a sensible appearance in a browser even when it is not preprocessed. Statement and control marks, which do not generate any implicit output, are handled as comments by HTML syntax, while expression marks appear literally in the browser, acting as a place-holder. In this way, a template can be edited as a regular static HTML page. The main advantage of this approach is that it allows the use of conventional HTML editors, such as Microsoft's Front Page, for building the template, requiring no programming knowledge.

Traditionally, templates are used for more declarative, static uses, while programming is used when there is a need for control structures and dynamic descriptions. CGILua allows a reverse in this conventional use: A template can be used as a kind of subroutine, while Lua is used as the declarative language. [Fig. 1] and [Fig. 2] illustrate this style.

```
<html>
  <head><title>Example Form</title></head>
  <body>
    <form method="POST" action="validate.lua">
    <!--$$ LOOP start="i=1", test="field[i]", action="i=i+1" $$-->
      $|field[i].label|$:
      <input type="text"
             name="$|field[i].name|$"
             value="$|cgi[field[i].name]|$"><br>
    <!--$$ ENDLOOP $$-->
      <input type=submit>
    </form>
    <font color=#ff0000>$|error_message|$</font>
  </body></html>
```

Figure 1: File `form.html`

```
field = {
            { name="project",   label="Project" },
            { name="year",      label="Base year" },
            { name="code",      label="Project code" }
          }
cgilua.preprocess("form.html")
```

Figure 2: File `form.lua`

Function `cgilua.preprocess` provides a degree of reflexivity: It allows a Lua script to process a template explicitly, as if the user had accessed that template. Notice that the file `form.html` describes how to show a generic form. The abstract specification of the form, on the other hand, is given in script `form.lua`, in the format of a table (`field`). The same table (`field`), which gives the abstract specification of the form, can be used to drive the creation of other pages.

Notice how CGILua can improve the management of Web sites even when used for static pages, since the use of parametric pages allows a developer to work in a higher abstraction level. For instance, the same template shown in [Fig. 1] can be used to create many different forms, when fed with different values for table `field`.

4. CGILua Architecture

Like many programs that use a scripting language, CGILua has two main modules: A *kernel*, written in C, and a *configuration script*, written in Lua. The kernel is the program called by the HTTP server when a user

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accesses a CGILua page. It creates a Lua environment, defines some new functions to Lua and then runs the configuration script. The configuration itself is almost 70% of all CGILua code. It decodes the data in the query (using Lua's built-in facilities for text handling), redefines some Lua functions to provide a secure environment where the user script will run, locates the user script and then runs it. Since all these steps are done by a script, they can easily be adapted to local needs by the system administrator. In addition, a site may have several configuration scripts, allowing differentiated environments for different projects. For instance, personal user pages may have a stronger security policy than the one enforced on institutional pages.

4.1 Portability

The tool's portability is ensured by the standards upon which it is based: Lua is fully implemented in ANSI C, which makes it portable for every platform that has a C compiler. The CGILua *kernel* is implemented following the POSIX standard and uses CGI as the interface with the HTTP server, since this is the only current standard for interfacing servers with external programs. These features allow the use of CGILua in different platforms without modifications, with the same source code. Currently, CGILua is being used with different servers in MS-Windows 95 and NT, and most popular Unix flavors, such as SunOS, Solaris, Linux, IRIX and AIX.

Despite its name, CGILua does not depend on the CGI standard. It has been developed in a way such that the interface with the server is totally done by the kernel. This architecture allows the porting of CGILua to other APIs, for example Microsoft's ISAPI or Apache API, improving the script's performance.

Since CGILua scripts communicate with the server only through the kernel, they are independent of the kernel's interface with the server. This allows the use of the same scripts, even with different kernels. At the time of writing, only a CGI kernel is available, with an ISAPI kernel under development.

4.2 Extensibility

Both the configuration script and the user script file can run other Lua files. In this way, Lua libraries can be loaded before or during the execution of the user scripts, offering new facilities. Sometimes, however, such extensions must be written in C, either for efficiency reasons (like a cryptography package), or because a pre-defined C interface (like a database) is accessed.

Again, the solution adopted by CGILua has the same general pattern: The kernel implements a generic mechanism for dynamic library loading, and the configuration script specifies which and how each package will be loaded. After this step, the script erases these loading facilities, thereby restricting the use of any unauthorized extension.

For instance, Lua itself offers no database facilities. Its standard libraries offer only access to files in conformance to the ANSI C facilities. DBLua is a Lua library that interfaces Lua with a standard database API, called DBGraf [Mediano 96], which offers access to different database systems, like mini-SQL and ODBC. This library is dynamically loaded by the configuration script, thereby offering all database facilities of CGILua.

In another example of its extensibility, CGILua is also being used in a network management system based upon SMNP. Again, a C package has been built to offer SMNP facilities to Lua, allowing a CGI application to get and set SMNP variables. In this way, different management applications can be built over the Web by writing simple CGILua scripts.

Another package that can be used with CGILua is LuaOrb [Ieru. 98], a binding between Lua and CORBA that allows a Lua script to manipulate CORBA objects in the same way as it manipulates local objects. LuaOrb is based on the CORBA Dynamic Invocation Interface, mapping its dynamic character to the dynamic type system of Lua.

These feature brings another level of utilization to CGILua, allowing different instances of the tool for different domains. Upon this perspective, CGILua is not only a tool for the creation of Web sites, but also a supporting tool for fully distributed applications.

4.3 Security Issues

A CGI script has the same security problems of any network server [Garfinkel 96], since it is invoked by remote requests; from this point of view, any CGI script can be considered a mini-server. Since CGILua activates user's Lua scripts, all security concerns must be extended to these scripts.

Lua is a language with secure semantics. There are no language constructions with undefined behavior. Lua programs are translated into byte-codes, which are then interpreted in a protected environment. There are no instructions to do real memory access or to call arbitrary C functions; the stack is fully controlled. Besides pure resource consumption, the only way a Lua program interacts with the external environment is through function calls. Therefore, in the realm of a Lua program, security issues can be focused on how to control the use of insecure functions.

In Lua, functions are first class values; Lua programs can freely create, redefine or erase functions at run time. Therefore, a simple solution for a secure environment would for be the configuration script to erase all "dangerous" functions before calling the user script. This solution is clearly too simplistic, since most of these functions can be used in restricted ways without security risk. For instance, a generic `open` function, which allows a script to write to any file, may be dangerous, but it can be restricted to open files in a pre-defined directory tree.

The solution adopted by CGILua has two parts. The kernel introduces a single generic facility that allows a Lua script to erase a global function while keeping a private access to it. With these facilities, the configuration script redefines the "dangerous" functions to more secure versions. Notice that the original functions are still accessible by the configuration script, and are used in the implementation of the restricted versions. With this solution, the whole Lua environment is configured in Lua itself, with the usual benefit: Flexibility. System administrators can change the configuration script to adapt the protected environment to their specific needs.

5. Final Remarks

Unlike many other Web tools, CGILua follows the same "minimalistic" principle adopted by Lua: Instead of providing a myriad of mechanisms for specific purposes, they provide a few generic *meta-mechanisms* to address general issues. In this way, they can handle rather diverse application domains, such as database query applications, document formatting, and Web gateways.

At a glance, the main features of CGILua are:

flexibility: The use of an extension language in the architecture of CGILua (and not only for writing user scripts) makes the tool highly flexible. Many characteristics, from error handling to security policies, can be easily tailored by the system administrator. The use of a scripting language greatly facilitates rapid prototyping, an important methodology for Web applications [Everitt 96]. Moreover, there are no fixed roles for what is written in Lua and what is written in HTML templates.

extensibility: Applications can load libraries written both in Lua and in C. Lua libraries allow the extension of internal CGILua facilities and C libraries allow the construction of Web gateways, as illustrated by the SMNP example.

simplicity: The whole system has less than ten thousand lines of code (~1500 lines for GCILua plus ~8000 for Lua). All its sources and binaries can be put on a single floppy disk. Its use is also simple. Most users are able to start using CGILua in less than half an hour. Lua is a small language, with a simple Pascal-like syntax and a simple semantics.

portability: CGILua runs on Windows NT, Windows 95, Linux, IRIX, Sun-OS, Solaris, AIX, HP-UX, FreeBSD, Unixware, SCO, OSF, and other platforms with essentially the same source code. Applications are fully portable: Any script written in one platform runs without changes in any other platform.

Despite its inherent academic nature, CGILua has also achieved industrial relevance, being employed in many commercial web systems, such as the dynamic pages of the Brazilian site of Xerox (in its system for choosing products and services). Another major example of industrial use is SIGMA (*Sistema de Gestão do Meio Ambiente*). SIGMA is a WWW system being developed for PETROBRAS (the state-owned Brazilian Oil company). Its function is to manage the procedure of obtaining environmental licenses and to inform users about rules and technical procedures. The system is part of a strategy to obtain the ISO 14000 certificate. Around one hundred people use SIGMA as a work tool on a daily basis. Moreover, parts of the system will be available to the general public. The system generates and collects information by an active communication with a database. DBLua is used to provide the connection through ODBC to an SQL Server database. A group of six people has been developing the system, having produced, to this date, around ten thousand lines of HTML templates and

Lua code. Approximately 85% of the system is built dynamicaly by CGILua templates, 5% are programs in Lua and the remaining 10% are static HTML pages. The large disproportion between HTML templates and Lua programs mirrors the emphasis given to the visual design: HTML components are intensively employed to fulfill layout constraints and requirements.

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VRoom: Three Dimensional Visualization of Hyperlinked Multimedia Documents

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Abstract: VRoom is a 3D-visualization system which transforms the structure and navigation of existing WWW documents into three dimensional spatial representations. It takes as input the URL of any existing HTML page, and explores outward, converting individual web pages and entire websites to a Virtual Reality Markup Language (VRML) based representation. The generated representations of the internet's structure, logical and functional relations, content and metacontent, can then be examined and interacted with in three dimensional space.

Introduction

Despite recent advances in VRML language standards and software, VRML and 3D information navigation is not widely used. Creating a large VRML web site is both difficult and expensive, while creating a HTML based web site can be done with a common text editor. The creation of a HTML to VRML translator would allow the public to make use of the advantages of VRML and three-dimensional visualization without learning a new language or sophisticated 3D modeler, increasing VRML's mass market appeal.

VRoom, a prototype HTML to VRML converter, is designed to be intuitive and easy to use. The end user is not expected to have any knowledge of VRML syntax or of three dimensional content creation. VRoom is designed to be used by anyone who would like to visualize the content of a web page or site using a variety of three-dimensional spatial metaphors .

Background and Related Work

The World Wide Web has become an environment that we interact with daily, yet navigating the web continues to be through a 2D magazine-like interface [1]. There is very little work being made on simultaneously visualizing structure, interconnectiveness, content, and meta-content of a site. Hollywood, through popular culture, represents the future of the Internet as being a fully 3D, immerse, interactive, animated, and exciting experience. Movies like Johnny Mnemonic, Disclosure, and The Lawnmower Man represent what the mass market has come to expect the future of the Internet and data navigation to be. Science fiction literature, such as Neuromancer and Snow Crash, push the concept of a completely immerse world of data driven visual representations. VRoom automates the creation of a prototype of that experience from existing data, visualizing the content and structure of the World Wide Web.

There are many systems that represent existing data in a three dimensional environment. Judith Donald's "Visual Who" demonstrated both the simplicity and potential of intuitive three-dimensional interfaces to existing data [2]. "Web Ciao" is one of several data-representation systems, abstracting content from the web and redisplaying the information in a condensed and useful form [3]. Projects such as "Stretch" demonstrated clearly that with the proper level of detail controls, vast amounts of structural information could be represented simultaneously without overloading the user interface [4]. There currently exists data specific VRML representation tools, such as representing web usage logs in a VRML graph, but none have been generalized yet.

The VRoom System

VRoom is designed to be completely intuitive. Through a web submission form, VRoom is passed the URL of a page and several optional parameters. All that is required by the end user is a target URL and a VRML capable web browser.

VRoom Sequence of Operations

VRoom uses standard VRML navigation techniques including walk, rotate, and zoom to object navigation. There are also several preset camera perspectives that the user can jump between. VRML 2.0 specifications will allow for much richer interactive content: nodes that react to a user's proximity, three-dimensional sound, and collapsing node trees are all in the process of being implemented in VRoom.

Representation Techniques

VRoom uses two methods of visualizing the structure of a web page or site. "Tree" mode, in which a site is explored using a breadth-first search, returns a cone-tree like structure of interconnected nodes, each page of HTML represented as a single node. Meta-information about each page and the site as a whole is abstracted and presented with the tree. In "Immersive" mode, each page of HTML is represented as a hallway. The hallways are connected by doors, while images and textual headings are presented in compressed form within each room. Having entered the Immersive corridor, the user can travel from page to page indefinitely.

The goal was to provide the user enough information for navigation without overloading the visual display. Titles of HTML pages are used, while images smaller than an arbitrary cutoff are ignored. The choice of what information to display, as well as what detail to go into, can be overridden by the user. VRoom is not meant to provide more than an overview, or a sense, of the content of a page or site, allowing for fluid navigation until the user reaches the desired information and returns to traditional viewing methods.

Figure 1: Rotated VRoom **Tree** Representation

Figure 2: Initial VRoom **Immersion** Representation

The media type of the node is represented by geometric shapes. Brightness represents how current the given data is, causing older inactive sections of the web to appear faded while recently updated sections stand out. The texture of visual media nodes, such as images or movies, are mapped with a compressed thumbnail, either from a preexisting source or generated on the fly.

In the tree representation, the branching structure represents the interconnection of different pages. The width of the branches linking the nodes represent the relative dominance of a link, using the font characteristics or area of a web page that a link would normally cover. Errors, such as missing or broken links, are highlighted. Outdated sections of the web would appear as dark, broken areas, where new sections would be brighter with less broken links, allowing a user to "cruise" the more recent information. At any point the user can jump back to regular hyperlinked navigation by clicking on a "HTML Cube."

System Implementation

The tree representation is generated through a depth-first search of a web site using a web crawling CGI script. Once the sites are tagged and their interconnectiveness determined, the CGI script returns to each page and gathers metadata. The architecture of the "Immersive" single room is based on the number of links leading out of the room. The size of the room expands accordingly. All links are positioned in front of the user in a semicircle of hallways leading out of the room.

VRoom's CGI is written entirely in Perl. The target pages are fetched into a CGI script using the libwww extensions to Perl, then parsed using regular expression matching. The resulting extracted information is analyzed, and then returned in VRML format. For textures and images, the VRML is linked to a second "thumbnail" generating script, which loads the image or other media from the web page, and returns to the user a compressed version of the media. The result is a highly compressed version of one page or an entire site, downloading extremely fast over a variety of bandwidth speeds.

Currently, VRoom is a proof-of-concept that creating a VRML immersive user experience from preexisting online hyperlinked information is possible. Much work remains until it is ready for mass-market use, however, it is a useful tool for exploring currently existing web pages in a variety of representations.

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The Blake Digital Text Project

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1. Blake Warp

On-line since February of 1996, the Blake Digital Text Project (*www.english.uga.edu/wblake*) offers the text of *The Complete Poetry and Prose of William Blake*, an on-line dynamic concordance to that text, and a continually expanding hypertext edition of the Romantic poet and artist's *Songs of Innocence and of Experience*, which he first published in 1794. As a quintessential multimedia author living through a time of revolutionary expectation and transformation, Blake offers an exemplary pertinence to current developments in the world-wide WebNet.

First of all–to the extent that a search of over 1,500 authors in the Chadwyck-Healey Literary Database can signify–it is appropriate to note for this conference that Blake's combined use of the words "web" (30 times) and "net" (21 times) prophetically exceeds that of any other major English poet, indeed, any other altogether with the exception of that later text technologist, William Morris. (Among other romantics, Wordsworth, for instance, uses "web" 4 times and "net" 8; Shelley, 6 and 10.) For Blake, a "net" or "web" is one of the signature productions of his embodiment of abstract reason, an unhappy giant form named "Urizen" who criss-crosses our horizons while a "cold shadow" follows him, "like a spiders web, moist, cold & dim"–this results at length in "a Web" which binds everything and is at the same time "twisted like to the human brain" and seen also as "The Net of Religion" (*The Book of Urizen*, 1794). The positive associations of "Web" stem from from the "*fabric*ation" and "*text*ile" production of weaving associated with the work of Blake's figures for imagination, "Los[s]" and "Enitharmon" who on looms with global warp and woof "Joy'd in the many weaving threads ... / Weaving the Web of life for Jerusalem. the Web of life" (*Jerusalem*, 1821). Blake's use of these words is deeply marked by his training and daily labor at engraving, the technology, so to speak, of making form and adding dimensionality by casting a net or web of lines onto a single plane.

2. Hyper Blake

Blake's anticipation of hypertextuality appears in his various experiments in bookmaking. His best-known work for instance, *Songs of Innocence and of Experience*, which he wrote, illustrated, etched, printed, and published, exists in two dozen copies whose 54 poems and designs are ordered in widely varying sequences. Indeed, some poems which first appeared in the 1789 *Songs of Innocence* move to *Songs of Experience* upon its publication five years later and then return back to *Innocence* in still later versions. The different sequences with their radically different juxtapositions can create very different readings. Before the advent of hypertext, appreciation of *Songs* was hampered by the usual decision of editors to follow a particular order which Blake happened to adopt late in his life for the last six copies. The limitation of this practice is evident when one figures that this order represents less than fifteen percent of the total number of copies. Even printed editions which supply information on alternative sequences do so in a cryptic fashion too time-consuming for most readers to decode.

The *Songs* hypertext obviates this difficulty by making the various links from a particular poem dramatically visible and instantly accessible. Links to detailed bibliographies and and to annotations and interpretation for each stanza are readily available. This electronic edition also makes possible the incorporation of audio into our experience of *Songs*, a capability appropriate for the work of an artist who composed his own melodies and whose work has frequently been set to music. From a pedagogical point of view, the musical interpretations are desirable for the power to make obvious almost instantly the reality of different yet convincing "interpretations" and that reading itself is as much a matter of such effective performance as the determination of some final truth.

A second large concern of the Blake Digital Text Project is to make available the text of Blake's writing in a scholarly and comprehensive fashion. To this end the Project was inestimably fortunate to obtain the permission of David V. Erdman, as the copyright holder, to use his standard, complete edition. This text has now been digitized and proofread several times and is freely available at the site. As an electronically archived text, the edition is available for significant enhancement in the form of SGML-TEI markup (now underway) and the inclusion of useful collateral texts. An important part of Blake's writing, for instance, includes his vigorous and provocative annotation of other texts; while the Erdman edition attempts to include enough context to situate each particular comment, the excerpts are perforce limited and local. The intention of the Project is to provide full text and collateral material for the relevant works so that the reader can branch from an annotation to the entire context. Obviously context ramifies infinitely, and material relevant to Blake's life and surroundings are a future goal of the Project.

The availability of Blake's text in electronic form enables the third major concern of the site, an on-line searchable concordance. The one previous concordance to Blake reproduces computer-generated output of more than thirty years ago, an age when big iron communicated in monospaced capital letters. That effort lists only words and not all words at that, as it omits those which occur very frequently and supplies only the whole line in which the word occurs, regardless of the word's position in the line. The Project's Perl-CGI scripts offer greatly enhanced search capabilities, including search for strings as well as words, wildcards, optional case sensitivity, link to surrounding context, alignment of search results in the central field, and Boolean searching. The digitizing of the Erdman text made possible its rearrangement so that concordance results are returned in a roughly chronological sequence.

For an artist who argues that his "Every word and every letter is studied and put into its fit place" (*Jerusalem* pl. 3), the ability to cross-reference instantly his entire *oeuvre* can open new insights. We begin to see, what is known already of oral-formulaic poetry like Homer's, that verbal artists think not just in words, but *with* them through their associated links. For Blake, who etched his own words, we will have in time the ability to cross-reference his various material renderings or calligraphy of particular words, to explore ways in which he toys even with single letters to play with signification.

As we move into the age of information and new concepts and practices of education it will entail, the idea of some self-reinforcing and self-regulating canon of Literary Masterpieces proves its own downfall as the time demanded for the return evidenced is generally perceived by the student to be disproportionate (i.e. "a waste of time"). Highest value goes now to those works that offer the most information and, more importantly, the most information (as practice) about using information, in the most accessible manner. Paradoxically, as previously normative literary acculturation disappears from much undergraduate experience, the prospective student's vision of the capacities needed for strong reading can be in itself so intimidating as to reinforce a defensive devaluing of literature. But Blake, in part owing to his contestation of previously normative literary culture, can engender value with compelling ease ("I am happy to find a Great majority of Fellow Mortals who can Eludicate My Visions & Particularly they have been Elucidated by Children" letter, Aug. 23, 1799).

Blake offers an exemplary text for the "creative reading" which Emerson urges (in "The American Scholar") and which we might encourage in our students. For aside from its curatorial function, the art and practice of what Emerson termed "creative reading" is what literature in the age of digital text has best to offer and what students most need or, at least, what teachers of those students need most. In the age of information, Matthew Arnold's canonical principle of "the best that has been known and thought" yields to a more pressing drive for high heuristic value, for cognitive development, for practical experience with semiotic potential or, in Blake's words, "what rouzes the faculties to act." So we might agree with Northrop Frye's argument of half a century ago that in understanding how to read Blake we understand "how to read the Bible, Milton, Ovid, and the Prose Edda" not just because, as for Frye, Blake offers a "beginner's guide to the understanding of an archetypal vision of which it forms a part," but because Blake's work offers an "archetypal" experience of the making of meaning, an experience all the more intense in the contemporary multimedia environment toward which that work points. He is our first great hypertextualist.

COLLABORATIVE LEARNING IN ASYNCHRONOUS LEARNING NETWORKS: BUILDING LEARNING COMMUNITIES

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ABSTRACT: One of the potential negative effects of online courses is a loss of social relationships and of the sense of community that is usually present on a traditional campus. Evidence is presented that collaborative learning strategies, which require relatively small classes or groups actively mentored by an instructor, are necessary in order for Web-based courses to be as effective as traditional classroom courses.

1. INTRODUCTION

The use of the Internet to deliver "anytime, anywhere" education is frequently referred to by the name "asynchronous learning networks" (ALN). There are two possible models for the use of ALNs. One model is the "mass market:" emulate the previous, primarily "one way" distance learning delivery modes of sending material to students, receiving back individual assignments or test materials, and providing some means of limited one-to-one communication between the student and the instructor. Web pages might replace video for lectures, and email might replace surface mail for student-teacher correspondence, but it is basically the same pedagogical model. This does have the advantage to educational institutions that education can be very "cheap;" hundreds or even thousands of students can be accommodated in a single course. Inexpensive adjuncts can be hired to do the grading and communication.

A very different model is to use the technology to try to create the kind of learning community that can arise in a good graduate seminar. Typically this is where the students learn with and from one another, collaboratively, and the faculty member structures the topics, provides expertise, and works closely with students preparing their projects for presentation to the group. In this model, the faculty member is directly and actively involved in facilitating collaboration and group interaction among the learners, on a daily basis. There are limits to the number of students who can be successfully accommodated in such a "learning network" [Harasim, et. al. 1994] format. Though the numbers are approximately double the 10 to 15 that face to face seminars can easily include without making it difficult for everybody to participate actively in all the sessions, they nevertheless make the "learning network" or "learning community" a relatively expensive educational delivery choice. The question is: is it worth it? Is online collaborative learning really superior to using the web for students to individually interact with educational materials? How do both compare to traditional classrooms of various types (the small seminar style classroom, and the mass lecture hall)?

Our evidence on these matters is limited, but this paper will briefly describe some studies that have been conducted which provide some data to answer these questions.

First, however, it will review the nature of collaborative learning vs. other models, and some of the issues raised by Web-mediated education.

2. THE END OF COMMUNITY?

The issues raised here are not just of "academic" concern; they have been increasingly raised in the mass media, and have become issues of general public concern. Consider, for instance, the rather sensational headlines used to describe the release of some preliminary findings from a study of Internet users in Pittsburgh. "Researchers find sad, lonely world in Cyberspace (The New York Times, see figure 1) and "Study: Internet Causes Depression" (The Washington Post- see http://search.washingtonpost.com/wp-srv/WAPO/19980831/ V000514-083198-idx.html) certainly would make a prospective faculty member or student pause before signing up for an online course.

The issues raised in the Carnegie Mellon study of Pittsburgh Internet users are serious ones, but the sensationalism is troubling. As my colleague, John Sener of Virginia noted in an online commentary, "I think the creator of this headline should be sent to the blackboard and made to write 100 times: 'Correlation does not necessarily imply causation.' "... More importantly, statistical significance has been confused with substantive significance. Since when does a decrease from 66 people to 63 people in one's active "social circle" constitute a "sad lonely world?"

Computer-mediated communication can be the basis for people with shared interests to form and sustain relationships and communities [Hiltz and Wellman 1997]. Compared to communities "offline," computer-supported communities tend to be larger, more dispersed in space and time, more densely knit, and have members with more heterogeneous social characteristics but with more homogeneous attitudes. Despite earlier fears to the contrary, online communities can provide emotional support and sociability as well as information and instrumental aid. However, for this to occur takes both the right software to support group communication (a topic beyond the scope of this paper), but also an emphasis upon collaborative learning approaches rather than individual learning.

Exhibit 1: Excerpts from a Recent News Story
August 30, 1998 Copyright 1998 The New York Times Company

Researchers Find Sad, Lonely World in Cyberspace By Amy Harmon

In the first concentrated study of the social and psychological effects of Internet use at home, researchers (including Robert Kraut) at Carnegie Mellon University have found that people who spend even a few hours a week online experience higher levels of depression and loneliness than they would have if they used the computer network less frequently... the new study... raises troubling questions about the nature of "virtual" communication and the disembodied relationships that are often formed in the vacuum of Cyberspace... Participants in the study reported a decline in interaction with family members and a reduction in their circles of friends that directly corresponded to the amount of time they spent online...

In measuring depression, the responses were plotted on a scale of 0 to 3, with 0 being the least depressed and 3 being the most depressed. Loneliness was plotted on a scale of 1 to 5... By the end of the study, the researchers found that one hour a week on the Internet led, on average, to an increase of .03, or 1 percent, on the depression scale, a loss

of 2.7 members of the subject's social circle, which averaged 66 people, and an increase of .02, or four-tenths of 1 percent, on the loneliness scale.

The subjects exhibited wide variations in all three measured effects, and while the net effects were not large, they were statistically significant in demonstrating deterioration of social and psychological life, Kraut said. ..."Our hypothesis is there are more cases where you're building shallow relationships, leading to an overall decline in feeling of connection to other people," Kraut said.

The study tracked the behavior of 169 participants in the Pittsburgh area who were selected from four schools and community groups.... Because the study participants were not randomly selected, it is unclear how the findings apply to the general population. It is also conceivable that some unmeasured factor caused simultaneous increases in use of the Internet and decline in normal levels of social involvement. Moreover, the effect of Internet use varied depending on an individual's life patterns and type of use...
[HomeNet is at: http://homenet.andrew.cmu.edu/progress/]

End of exhibit

3. WHAT IS COLLABORATIVE LEARNING?

Passive approaches to learning assume that students "learn" by receiving and assimilating knowledge individually, independent from others [Bouton and Garth 1983]. In contrast, active approaches present learning as a social process that takes place through communication with others [Mead 1934]. The learner actively constructs knowledge by formulating ideas into words, and these ideas are built upon through reactions and responses of others [Bouton and Garth 1983; Alavi 1994]. In other words, learning is not only active but also interactive.

In particular, collaborative or group learning refers to instructional methods that encourage students to work together on academic tasks. Collaborative learning is fundamentally different from the traditional "direct-transfer" or "one-way knowledge transmission" model in which the instructor is the only source of knowledge or skills [Harasim 1990].

In collaborative learning, instruction is learner-centered rather than teacher-centered and knowledge is viewed as a social construct, facilitated by peer interaction, evaluation and cooperation. Therefore, the role of the teacher changes from transferring knowledge to students (the "sage on the stage") to being a facilitator in the students' construction of their own knowledge (the "guide on the side"). Some examples of collaborative learning activities are seminar-style presentations and discussions, debates, group projects, simulation and role-playing exercises, and collaborative composition of essays, exam questions, stories or research plans [Hiltz and Turoff 1993]. This new conception of learning shifts away the focus from the teacher-student interaction to the role of peer relationships in educational success [Johnson 1981].

3. THE IMPORTANCE OF COLLABORATIVE LEARNING IN AN ALN ENVIRONMENT

There is no question that ALN's have disadvantages as well as advantages in comparison with traditional classrooms. The major advantage is convenience ("anytime/anywhere"), which in turn facilitates students being able to have more total interaction each week with the teacher and with peers, and being able to learn at the pace

and the times best suited to their individual needs. The major shortcomings are (1) limited bandwidth or "media richness" [Daft & Lengel 1986] and (2) the frustration of waiting an unpredictable amount of time to receive any reaction or feedback. The weaknesses of ALN as a mode of communication is the decrease of the feeling of "social presence" of the teacher and the other group members. In turn, this can severely decrease feelings of motivation and involvement, and thus negatively affect the learning outcomes. However, an emphasis on collaborative learning can emphasize the advantages and overcome some of the disadvantages of asynchronous computer-mediated communication.

Several studies have shown that collaborative learning strategies result in more student involvement with the course [Hiltz 1994], and more engagement in the learning process [Harasim 1990]. Collaborative learning methods are more effective than traditional methods in promoting student learning and achievement [Johnson 1981], and enhance student satisfaction with the learning and classroom experience. The next few pages briefly summarize some recent studies that provide evidence that collaborative learning is very important to the success of ALNs in creating positive outcomes for students.

3.1. Field Trials on the "Virtual Classroo m®" at NJIT

In an ongoing project at NJIT spanning more than a decade, data have been collected not only on all students in sections using its ALN system, the Virtual Classroom® (VC), plus web pages and videotapes or CD ROM's for lecture type material, but also in sections of the same course taught by the same instructor or set of instructors, using roughly the same syllabus, in three other modes: traditional face-to-face, "traditional" distance mode of all video, and a combination of face-to-face and VC. The results for the post course questionnaire for a recent three year phase of the project (over 600 responses from students who used the system) and grade data for all three years will be summarized here. In the post-course questionnaire, students were requested to compare their experiences in their course which used VC, to that in other college courses delivered face-to-face. Generally, the results of these subjective evaluations were positive. For example:

- Over half of the students in the VC + video experimental sections felt that having this option available enabled them to complete more courses that semester than would have otherwise been possible (and thus make faster progress toward their degree).
- Subjectively, the majority of students feel that the V C improved the convenience of course access (73%), access to their professors (65%) , and the quality of learning (58%).
- Correlation statistics support the theoretical premise that active participation online by both faculty and students, and the use of group or collaborative learning strategies in ALN, are positively related to desirable outcomes.

A multi-item scale was constructed to measure perceived degree of collaborative learning, which correlated significantly ($p=<.001$) with scales measuring overall course outcomes ($R= .31$, $N= 749$) , and overall rating of the virtual classroom experience ($R=.30$; $N= 632$).

Outcomes as measured by grades in the courses show no significant differences between modes. Only two courses showed significant differences, one in each direction. Course grades are only weakly correlated with most variables measured, except for overall grade point average ($R^2= .21$, $N= 1531$, $p = <.001$).

Though the degree of perceived collaborative learning in the course correlates significantly with perceived outcomes, as noted above, "correlation is not causation." Being online is confounded with collaborative learning. In addition, all of the courses supposedly used collaborative learning approaches (though this was implemented better and more consistently in some courses than in others). We need a more experimental approach to test whether collaborative learning is a key mechanism in making ALN's effective, and the extent to which collaborative learning groups can be as effective as face-to-face collaborative learning groups.

3.2 A Field Experiment on Collaborative Learning at NJIT

Recently completed dissertation research [Benbunan-Fich 1997] is based on a field experiment that compared groups and individuals solving ethical case scenarios, with and without computer-mediated communication support. A 2x2 factorial design crossing two modes of communication (offline with a task time of two hours vs. asynchronous computer conference with a task period of ten days; these times were established as optimal in pilot studies) and two types of teamwork (individuals working alone vs. individuals collaborating in groups) was designed to assess the separate and joint effects of medium of communication and collaborative vs. individual learning strategies. In both conditions, undergraduate students in a Computers and Society course received an ethical case scenario comprising the task one week ahead of time, and were permitted to use whatever written or other materials they wished while discussing the case. In the individual offline condition, students solved the case individually, in an in-class exercise like an open-book quiz, and received individual grades based on their own performance. In the individual online condition, students simply posted their individual responses online. In the group offline condition, team members discussed and solved the case by interacting face-to-face and prepared their report. In the group online condition, team members interacted asynchronously using a computer conference as the only means of communication, and submitted a group report.

Assignment of the 136 subjects to experimental conditions was done as close to randomly as possible some students were truly "distance" students and could not be assigned to come to campus. Students randomly assigned to a group condition were then randomly assigned to a specific group. Perceived learning was measured immediately after the experiment in the post-test questionnaire, using a seven item scale adapted from Hiltz (1994; Chronbach's alpha = .92). Quality of the analysis produced was rated by three expert judges on a number of dimensions, including the extent to which the correct legal principles were identified and applied to the scenario. "Actual" learning was measured in the final exam with two similar ethical scenarios, two weeks after the experiment ended.

The results indicate that working in groups, instead of alone, significantly increases motivation, perception of skill development and solution satisfaction. In terms of self-reported learning [Hiltz & Benbunan-Fich 1997], there is, as hypothesized, an interaction between medium of communication and group vs. individual learning. According to the results, conditions with (or without) both factors, i.e., individuals-manual and groups online, perceived higher learning than conditions in which only one of the factors was present.

The implications for ALN are that putting individuals online to interact with course materials is not as effective as the traditional classroom, but that using collaborative learning approaches can make online learning at least as effective as the traditional classroom.

3.3. A Field Experiment at Penn State

A total of 43 graduate students participated in a recent experiment at Penn State Harrisburg conducted by Ocker and Yaverbaum [1998]. The vast majority (40) were part-time students with full-time employment (38). All students were enrolled in the core information systems class required of all MBA and MS/IS students. The authors point out that although there has been more than a decade of literature on computer-mediated communication in education, the research has been unclear as to whether it is an effective replacement for FtF collaboration.

This study sought to add to this body of research by exploring the effects of two modes of collaboration on student groups. Following a repeated-measures experimental design, each student group collaborated on two case studies, one using face-to-face collaboration and the other using asynchronous computer conferencing technology as a means of collaboration. The findings indicate that asynchronous collaboration is as effective as face-to-face collaboration in terms of learning, quality of solution, solution content, and satisfaction with the solution quality. However, students were significantly less satisfied with the asynchronous learning experience, both in terms of the group interaction process and the quality of group discussions.

4. SUMMARY AND CONCLUSION: CREATING AND SUSTAINING LEARNING COMMUNITIES

Collaborative learning designs are more effective for online learning than pedagogical approaches that emphasize individuals working alone with materials posted online. Software structures can be constructed which will support group collaboration. However, they can only facilitate the desired behavior, not produce it. For the group to adapt a structure of interaction that is collaborative in nature, the instructor must mold, model, and encourage the desired behavior, and the students must be able and willing to participate regularly.

A number of studies indicate that when collaborative learning is used in ALN delivery, "objective" results in terms of mastery of material and efficiency of education tend to be equal to or better than traditional face to face classes. However, even when collaborative learning is used, the current "state of the art" of systems plus pedagogy seems to lead to less feeling of community than is typically obtained in face to face small group interaction. The question of how to build and sustain online learning communities is thus a prime area where researchers on ALN ought to be focusing their efforts.

The most basic premise from which all online teaching should begin is that the goal is to build a learning community and to facilitate the exchange of ideas, information, and feelings among the members of the community. Every "electure" (electronic lecture) should be designed to include questions for discussion or response among groups of students, rather than simply representing one way transmission of "knowledge." The students, as well as the instructor, should be encouraged to raise new topics and ask questions of the class; and to respond to one another's contributions. This kind of daily interaction does demand constant attention from the instructor, and thus is a labor-intensive mode of course delivery.

Colleges and universities ought to be concerned not with how fast they can 'put their courses up on the Web," but with finding out how this technology can be used to build and sustain learning communities. This does have fiscal implications: using collaborative

learning approaches requires relatively small classes or sections of courses, which need daily attention from a faculty member.

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Improving Learning Processes in Institutions of Higher Education By Incorporating High-Risk Web Technologies

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Abstract: Just as technology trends improve and we approach the next millenium, so have our abilities to perceive farther and visualize new methods of testing. With the assistance of learning technology consultants in the Technology Teaching and Learning Center (TTLC) at University of Houston-Downtown, professors have shifted their paradigms and are taking the leap to use more high-risk web technologies in their courses. One that has become an instant hallmark is delivering exams via the Internet.

1. Introduction

A new state of consciousness has taken form – the reality that learning can take place outside the confines of a classroom. This is not meant only in terms of the ever-evolving distance learning and video conferencing, but also by using web technologies as a supplement.

In one of the nation's most diverse institutions of higher education, the University of Houston-Downtown (UHD) in Houston, Texas, students are grasping ideas and concepts through non-traditional teaching methods. For example, faculty members incorporate electronic mail, listservs, and World Wide Web home pages into their classes to provide more innovative ways of delivering instruction. Professors have the opportunity to incorporate the latest computer technologies into their courses with the assistance of learning technology consultants like us who work inside the UHD Technology Teaching and Learning Center (TTLC). The TTLC provides resources and support for the university community to explore new technologies and capitalize on their potential to improve learning. It offers a wide range of programs, tools, and activities that enhance the education and opportunities available to the diverse student body of this dynamic university. By including such learning facets, students are ready to venture into the "real world" being more confident, prepared, and capable of using technology. They are ready to surpass their competitors and end up on top.

Just as technology trends improve and we approach the next millenium, so have our abilities to perceive farther and visualize new methods of delivering instruction. With this in mind, professors at UHD have shifted their paradigms and are taking the leap to utilize more high-risk web technologies in their courses. One that is becoming an instant hallmark is delivering exams via the Internet.

The development of authoring tools such as Asymetrix's ToolBook II Instructor enables more professors to break the barriers of test taking. With advanced programs such as this, students can take tests on computer workstations inside computer labs within their university, at distant educational sites, or at home.

2. Planning and Preparation

Throughout the 1997-98 school year at UHD, faculty members took the leap of developing online exams to be delivered via the Internet as a supplemental method of giving examinations during instructional television (ITV) courses. A great deal of planning and preparation took suit before the initial test taking, but ultimately the exams were successfully administered and conducted.

After assessment of the current software titles available in the TTLC, Asymetrix's ToolBook II Instructor 5.01 was the software of choice.

ToolBook II Instructor is a high-end authoring tool designed for the flexible creation of content-rich online learning applications. Its wide array of tools and predefined content includes wizards, widgets, and templates. It comes with a catalog full of preprogrammed interactive objects that can be dragged and dropped into applications. The authoring tools provide for a range of distribution options that are sure to meet many users needs. Because it was necessary to deploy over the Internet, we decided to use the HTML & Java export option built into the ToolBook II authoring environment.

Using the ToolBook II "Export for Web" feature, the online exam was converted directly to an Internet-ready format (a combination of HTML and Java) for delivery on the World Wide Web. Anyone with Internet access, a web browser, and Uniform Resource Locator (URL) of the exam can take the test without having to install a plug-in.

After determining the software application to use, we (the technology consultants) then had to provide training for the faculty members. This involved familiarizing the professors with the information needed to create a ToolBook II Instructor Book (examination), which includes learning how to add:

- a title page
- duplicate pages
- text fields
- question widgets
- navigation widgets
- an exam summary page
- a scoring button

In addition, time management was very important in the development of the online examinations. Given that faculty members participate in a number of activities including teaching courses and attending conferences, we wanted to make sure they learned the skills necessary to build successful exams. As technology consultants, it is our responsibility to train the faculty specifically on a need-to-know basis. This included providing one-on-one hands-on training, detailed documentation, and constant support.

3. The Components and Risks

During the online exam development process, there were a number of unexpected factors discovered. These factors are what allowed us to learn that online testing is indeed a high-risk web technology.

3.1 Question Widgets

All of the ToolBook II Instructor 5.01 question widgets are created from ToolBook II objects. Many, particularly multiple-choice question widgets, consist of groups of objects in fours. The question widget behavior is specified using scripts. If a question widget's default does not meet the needs of your application, you can customize it. The question widget in the Standard Widget Catalog are constructed from standard ToolBook II objects, so you can modify them easily if you are comfortable with OpenScript programming. However, the question widgets in the Internet Widget Catalog are implemented not with OpenScript, but with Java. These question widgets can not be modified in the same way the standard question widgets are modified. This proved to be a problem with high-risks involved. For instance, if a professor has a multiple-choice test with five answers rather than four, the question widgets (which are pre-programmed with four options) would need to be modified using scripting that the professor may not have time to learn.

3.2 Question Scoring

In one instance, we actually created an exam with 50 questions using a question widget with four choices. We manually duplicated one of the choices before setting the question properties for each question. So, instead of having only options a, b, c, and d, we had a, b, c, d, and e. After setting the scoring properties for each question widget and exporting the test as HTML, we were faced with the problem of answer e being scored correctly even if the correct answer was defined as a, b, c, or d in the scoring properties. This was discovered when we took the exam and selected e as the answer for each question for testing purposes. We found that a solution would be to create the test with four multiple-

choice questions. This allowed us to avoid working with any scripting and gave us time to focus on the exam development.

3.3 Java Class Files

Before the exams could run effectively, ToolBook II Java classes needed to be downloaded from the Asymetrix web site (http://www.asymetrix.com) and then installed in a designated area on the web server where the exam would be located. If an exam were accessed during a time when the necessary Java class files were not installed on the server, then the test would not function properly.

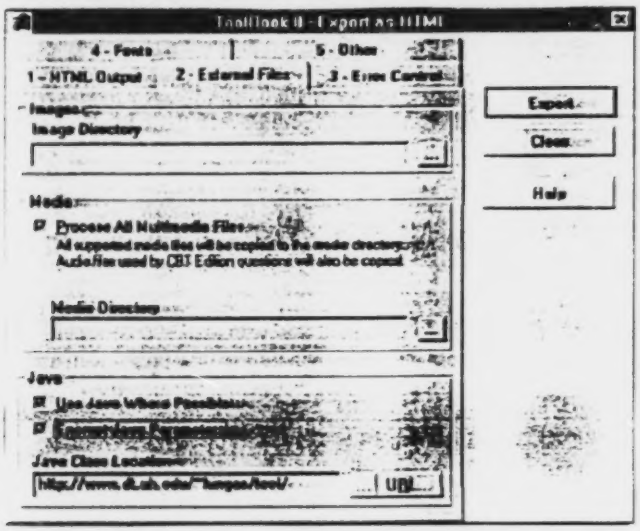

Figure 1: Screen view of the window one must access in ToolBook II Instructor 5.01 in order to indicate the Java Class Location.

3.4 Scoring the Exam

Scoring properties were setup for the examinations. This was configured in the Instructor's Book Properties. When these settings were defined correctly, it allowed for the scores to be sent to the student. When the student entered the exam, he or she was prompted with the login window to enter the correct name and email address in order to receive the score.

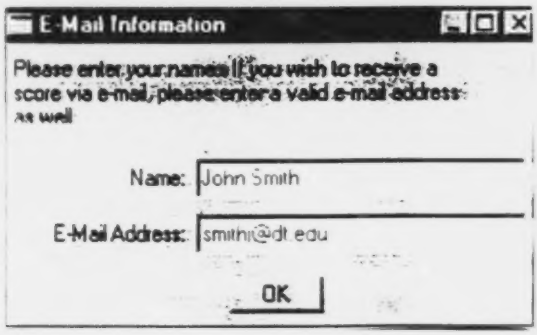
E-Mail Information
Please enter your name if you wish to receive a score via e-mail, please enter a valid e-mail address as well
Name:
John Smith
E-Mail Address:
smithj@dt.edu
OK

Figure 2: Screen view of the window students must fill out so they may receive their scores and so the instructor will know is taking the examination.

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In the Instructor Book properties, there is also an option to send a log to the professor so that he or she can find out more information, like the computer machine name from which the student took the exam. This is excellent information to have for security purposes.

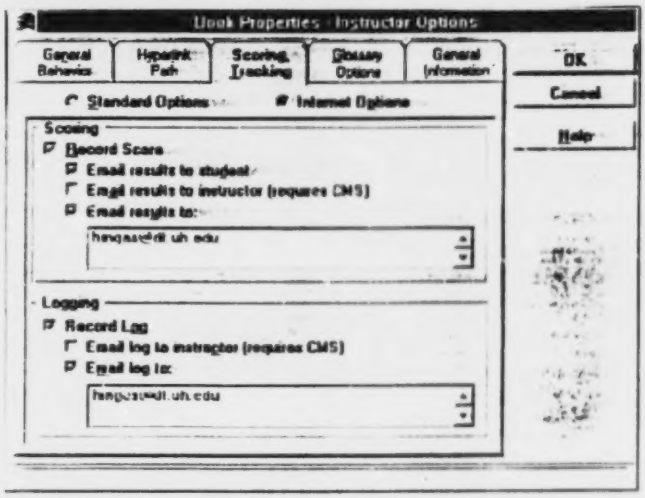

Figure 3: Screen view of the Scoring, Tracking window in the Instructor Book Properties.

During an actual examination we discovered that some student logs were not emailed to the professor. Though tested continuously, we were still unable to determine the reason why they were not received.

3.5 Web Browser

Before deploying the exams over the Internet, it was important to know what computer software the students enrolled in the courses had access to at their locations. The ToolBook II Instructor 5.01 requirements specify that tests should be accessed using the Netscape Navigator Gold 3.01 web browser. Through trail and error, we discovered that exams could occasionally be accessed using a lower or higher version of the Netscape browser. However, during the actual testing situation we required that students access the exams using Netscape Navigator Gold 3.01.

4. High-Risk Precautions

4.1 Security Issues

Before and during the examinations, security was an important issue. The security precautions we took included setting restrictions on the time students could access the exams and having a proctor available at distant locations during the tests to verify that the students taking the test were actually registered in the course. In addition, we set up restrictions which enforced students to provided usernames and passwords before entering the online examination web pages.

4.2 Back-up Plan

When setting up online exams it's also important for the instructor to have a back-up plan in case the technology fails. We prepared for this by instructing the students to bring scan-trons on the exam date and enter their answers on them as they selected their answers on the computer. Also, it was important to have more computers ready than students registered in the class in case one or more computers experienced technical difficulties during the examination.

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5. Conclusion

By including such a high-risk web technology as online testing into courses, professors are able to evaluate the effectiveness of incorporating this type of testing in their distance learning courses and in turn recommend this use of the technology to other faculty members. In our organization, we learned that the professors as well as the university and technology department benefit in this process. By addressing and accessing the online testing issue through the development of tests created with such products as Asymetrix ToolBook II Instructor, individuals see that the worth is invaluable to the entire university from the administration to the students.

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Toward Context-Sensitive Filtering on WWW

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1. Introduction

Browsing is one of the most popular ways to gather information in WWW. To support a user to browse WWW pages, modeling of the user's interests is an important issue. Although there are several promising methods to infer the interests from the user's browsing behavior, they assume that the interests are consistent during the information gathering. However, during browsing, the user's interests often shift depending on the local context of the browsing. We have proposed a method to model the user's shifting interests from the browsing history. An information filtering facility using the model of the interests has been implemented for CD-ROM encyclopedia. We call the filtering method "Context-Sensitive Filtering," CSF for short. The effectiveness of CSF for browsing in CD-ROM encyclopedia has been confirmed by an experimental evaluation by real users [Hirashima 98].

In this paper, we report a work-in-progress project to apply CSF for browsing in WWW pages. Pages in CD-ROM encyclopedia follow basic guidelines to design hypertext. Therefore, one page has one topic and the content is concise to be able to read through it briefly. Modeling of user's interests of CSF depends on the characteristics of the page. In WWW, however, pages often don't follow the guidelines, for example, one page has several topics, or the volume of the content is too much. Therefore, modification of WWW pages is necessary to use CSF effectively. In this paper, first, framework of CSF is described. Then, we report results of preliminary experiment to apply CSF to WWW pages directly. Based on the results, we propose modification methods of WWW pages following HTML specifications.

2. Outline of Context-Sensitive Filtering

Figure 1 shows an example of browsing history. Here, an ellipse is a node: letters included in the ellipse are indexes which characterize the node. BN means an already browsed node in browsing history and CN means a candidate node as the next browse node. Assuming that a user browses BN-1, BN-2 and BN-3, in order, the user will then browse the next node through Index-g. Here, there are three candidate nodes, CN-I, CN-II and CN-III, each of which includes Index-g.

We model user's interests as the pairs of an index and its weight. It is assumed that when the user visited and accepted a node, the user was interested in the indexes of the browsed node. It is also assumed that the user is more interested in an index included in more nodes and more recently browsed nodes. Based on these assumptions, each node is weighted depending on the time order. Then, the weight of an index is calculated as the sum total of the weight of nodes in which the index is included. By using the weight of the indexes, the weight of each candidate node can be calculated. In the browsing history, the three candidate nodes are ordered CN-I, -II and -III. Here, if the user browsed nodes BN-2, BN-1, and BN-3 in order, the weight of Index-b is heavier than Index-d, conversely. Then, the order of CN-I and CN-II is exchanged. Thus, this method is sensitive to user's browsing history.

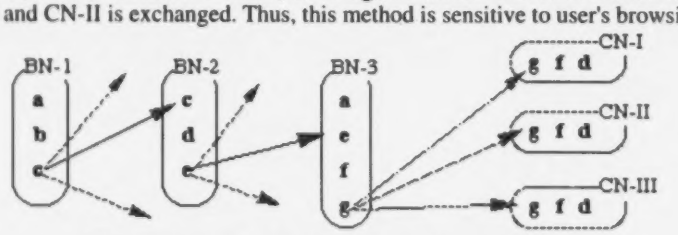

Figure 1. An example of browsing history.

3. Context-Sensitive Filtering on WWW

3.1 Framework of Context-Sensitive Filtering on WWW

We have confirmed that CSF is effective for free browsing in CD-ROM encyclopedia [Hirashima 98]. In this

section, a browser for WWW pages with CSF is introduced. The browser consists of three windows: Page Window, Search Window and Selection Window. Page Window shows the content of selected page. There are two ways to select a page. The first is selection of URL, like usual WWW browser. In this case, CSF doesn't work. The second is selection with CSF. The selection procedure with CSF is as follows. First, a user can set an index as a keyword for retrieval in Search Window. Here, the index should be included in the page shown in Page Window. Then, WWW pages which share the index are retrieved. Here, the WWW pages should be already gathered in local database. This is the same way with usual search engines. CSF monitors the user's browsing history and models the user's interests continuously. Based on the model, CSF orders the retrieved results in Selection Window.

3.2 Preliminary Experiment

To implement CSF for WWW pages, there are two apparent problems: (1) gathering WWW pages, (2) indexing WWW pages. These are common issues for search engines. For the first problem, we gathered users' browsing histories by using proxy function of CERN httpd. For the second problem, the pages were analyzed by Japanese Morphological Analysis System: JUMAN (http://www.forest.dnj.ynu.ac.jp/~jun/jum_chaframe.html) and every noun was used as an index of the page.

In the preliminary experiment, two thousand five hundred WWW pages were gathered. Ten users were asked to browse the WWW pages with the browser shown in Figure 2. However, we couldn't confirm that CSF is effective. Pages in the encyclopedia follow basic guidelines to design hypertext. Therefore, each page has one topic and the volume is adequate to read through a page briefly. These characteristics are necessary to apply CSF effectively because it is assumed that when a user visited and accepted a node, the user was interested in the indexes of the browsed node. In WWW, because one page often has several topics or too much volume to read through it briefly, the assumption isn't adequate.

3.3 Modification of WWW Pages

The purpose of modification of WWW pages is to give the two characteristics to the pages: (1) one page has one topic, (2) one page has adequate volume to read through it briefly. To realize the modification, partitioning methods of WWW pages are described in this section. First, partitioning following HTML specifications is described. Then, partitioning by heuristics is reported. Here, although CSF uses the divided pages to models user's interests and to order search results, Page Window deal with the whole page. So, in Page Window, the part of the divided page is shown first, but the user can see other parts in the whole page in the same way as usual browser.

Because WWW pages written by HTML, every page has the structure defined by HTML specifications. By using the specifications, the content of the page can be divides into several document blocks. The Headings in the BODY elements represents hierarchical structure of HTML document. The TITLE element in the HEAD elements represents the title of the document. Following HTML specifications, Headings and the TITLE element compose a tree structure. Each Heading divides a document into several smaller document blocks. Then, the lowest Heading makes the leaf document block. This leaf document block is a divided page which is dealt with a page in CSF. The divided page is characterized not only by the content of the divided page, but also by the upper structure in the tree structure. Therefore, indexes of the divided page consists of indexes which come from the content of the page and come from the upper structure of the page.

However, WWW pages are often written not following HTML specifications. For example, font specifications sometimes used as headings. In such case, the largest font part is regarded as H1 level, and so on, is an useful heuristics. The leaf document block generated by Headings, often include too much content to read through it briefly. In such case, paragraph tags can be used to divide the document block again. In order to realize CSF for WWW pages, such heuristics to divide HTML documents are important.

By using the above modification, divided pages are listed in Selection Window. As the explanation of a page in Selection Window, a summary of the hierarchical structure of the page are shown. The summary consists of the first one line of TITLE element, H1 element and so on. When a user selected a divided page, the whole page is provided to Page Window and the part beginning with the divided page are shown.

4. Conclusion Remarks

This paper described a work-in-progress project to apply CSF for browsing in WWW pages. Currently, partitioning facility by using HTML specifications are implementing. We will prepare much more heuristics to divide WWW pages, implement partitioning facility with the heuristics and evaluate CSF for WWW pages. To deal with multimedia, such as pictures, is our future work.

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An Experimental Study of Social and Psychological Aspects of Teleworking: The Implications for Tele-Education

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Abstract: The last few years have seen a growth in interest in the concept of distance-learning in the field of education and in the use of teleworking to provide a way of conducting work from home. Current predictions suggest that these could become very significant ways of learning and working in future.

The contention of this paper is that distance learning will continue its early adoption of many of the existing techniques and technologies used for teleworking. It therefore starts by describing an investigation into the working environment of teleworking, examining the currently debated issues associated with it, and laying out the potential advantages and drawbacks.

Views solicited from workers currently operating within a teleworking regime in a large UK organisation are presented. A small-scale experimental study of the psychological and sociological effects associated with teleworking is then described, and the results discussed. Finally, the implications for tele-education are considered.

1. Teleworking

The term teleworking is not one that is clearly defined, and it is often used to encompass a number of different styles of work. For example, it includes people working *at home* (such as programmers), people working *from home* (such as salespeople), and people working *at workcenters* (such as telecottages and satellite offices).

[Gray et al 1995] defines teleworking as 'a flexible way of working which covers a wide range of work activities, all of which entail working remotely from an employer, or from a traditional place of work, for a significant proportion of work time.' He goes on to point out that teleworking may be on either a full-time or a part-time basis, and that the work often involves electronic processing of information, and always involves using telecommunications to keep the remote employer and employee in contact with each other. Whilst this is a useful working definition, it should be noted that it excludes traditional 'outworkers' as well as those who work at home only occasionally. Other terms commonly used in place of teleworking are telecommuting, networking, remote working, flexible working, and homeworking.

Gray (op cit) classifies as *full-time* homeworkers those who work at home for most of the working day, visiting an office occasionally for meetings or to pick up material. Computer programmers, systems analysts, catalogue-shopping telephone order agents, and data entry clerks fit into this category. *Part-time* homeworkers he defines as those based in an office but spending two or three days a week working at home. At present these tend to be managers and professionals who can justify the additional expenditure on information technology equipment at home and work, but as hardware prices continue to fall dramatically it will increasingly become an option for a wider range of workers.

Mobile or *location-independent* teleworkers are those who spend most of their time out of the office or home, either 'on the road' or in customers' premises. Salespeople, service engineers and consultants are typical of this grouping. Throughout the world, location-independent teleworkers represent one of the most populous and well-established groups of teleworking.

Another identifiable group of teleworkers is those who work at a work center. These can vary from a rural telecenter or telecottage to a company satellite office - a small office remote from the company head office that is not self-sufficient but relies on communications with the head office. Retaining some of the ethos and work patterns of the conventional central office working, the work center may be more attractive to workers who may find it hard to adapt to full homeworking and to managers who might find difficulty with managing a set of geographically dispersed individuals. At the same time, telecenter working offers some of the benefits of homeworking.

2. Claimed Advantages and Disadvantages of Teleworking

Teleworking can bring advantages for the employer, the employee and the environment. It may also provide new job opportunities for the disabled, alleviating some of the effects of immobility.

[Reid 1993] suggests that cost savings can be achieved through teleworking by reducing the need for centrally maintained offices in expensive locations. Further, [Gray et al 1995] and [Heap 1995] find teleworkers to be more productive than office bound staff who have to travel to work and tend to suffer a higher level of stress. Teleworking is generally regarded as a 'green' activity, primarily because of the reduction in travel, the consequent fuel savings and lessening of pressure on congested city centers and overstretched public transport.

Against this, Reid (op cit) cites loss of status and professional isolation as potential dangers for workers moving into teleworking. There will need to be considerable change in management attitudes in many organizations and contractual arrangements for teleworkers will have to strike a careful balance which allows them to feel an integrated and valued member of the workforce as opposed to an inferior and exploited individual.

Worse, teleworking could be seen as a halfway house to redundancy. For many workers, the social interaction of the work place is all-important, and were the isolation of teleworking to be enforced on these workers, they could find the job no longer worthwhile.

3. Psychological Aspects Associated with Social Isolation

For the individual, the disadvantages of becoming a teleworker are predominately psychological. In some teleworking scenarios individuals may be totally isolated from interaction with society. This may be either through their own choice as in the case of a writer or musician retreating alone to the mountains to compose, or else through necessity such as a research scientist who is required to take seismic readings for an oil company in a desolate environment such as Antarctica. In the latter case the only contact with others may be through infrequent e-mail messages detailing instructions, and it is in such situations that the effects of social isolation on the individual are likely to be at their most severe.

[Myers 1996] draws a distinction between loneliness and aloneness, pointing out that an individual can feel lonely in the middle of a crowded party, and yet not feel lonely when working alone in an office on an absorbing piece of work. It would seem vitally important for a socially isolated teleworker that they should be in regular contact with others on a social level and not just through their working environment if they are to stay mentally healthy and continue to perform their work duties efficiently. This social contact could be achieved through using modern technology such as video-conferencing, cellular telephones, fax and electronic mail, all of which should help to lessen the individual's feeling of loneliness.

Perceived loss of status can be another major problem for some individuals both inside and outside the workplace. [Messe, Kerr and Sattler 1992] note that in many everyday and laboratory situations, people assigned a superior status come to see themselves as meriting favorable treatment or as capable of superior performance. [Humphrey 1985] showed this effect in a simulated business office in which subjects were arbitrarily assigned as 'managers' or 'clerks'. After the role-play exercise, 'managers' and 'clerks' alike judged the randomly created 'managers' to be more intelligent, assertive and displaying leadership qualities. Similar effects of assigned status on performance have been found in experiments with elementary school children [Jemmott and Gonzalez, 1989] and [Musser and Graziano 1991], and demeaning roles were found to undermine self-ability by [Myers 1996].

It would seem vitally important, therefore, that if an employer were to decide to deploy some of their employees in a teleworking environment they should ensure that they help them overcome these dangers and make a smooth transition into the teleworking environment. For example, prestigious sounding teleworker job titles could be created, and teleworking employees could receive special mentions in company bulletins or newsletters.

4. Teleworkers' Views

In order to ascertain views of teleworkers themselves, a questionnaire was devised and sent to teleworkers working for a UK telecommunications company. The workers held a variety of job titles such as teleworking systems engineer, technical advisor, technical officer, development engineer, and teleworking technician.

Length of teleworking service was found to vary from two to eight years with an average of four years, and the number of days spent away from the office/workplace environment ranged from three to five days per week with an average of four days per week. The teleworkers themselves commented favorably on the flexibility which their style of working allowed, particularly in terms of travel between work locations, but also in terms of scheduling the work. There was relatively little response when asked to list disadvantages, and was confined to the loss of the social banter of the traditional office. The general feeling was that it could be extremely difficult to return to the more rigid traditional workplace after having experienced teleworking.

5. Teleworking Experiments

One of the major debates revolving around teleworking in the present day working climate is whether the quality of work using modern teleworking methods such as electronic mail is to the same standard as that produced using more traditional working practices [Gray et al 1995] and [Reid 1993].

To investigate this controversial issue further, two experiments were devised to allow the observation of a team of three subjects while they worked together in trying to solve a problem. For comparison, they were firstly observed working in a traditional working environment around a table, and then working in isolation from each other using only electronic mail for communication as in a typical teleworking environment.

Both experiments had a set time limit to generate a realistic level of stress as might be found in this situation in the real world. As a measure of the stress levels experienced by the subjects under the two working environments, their pulse rates were taken before and after completion of the tasks in both experiments.

In the first experiment, the three subjects were isolated in a room together with a standard survival-type problem-solving exercise – the establishing of importance ratings to fifteen items to a space crew stranded on the moon. The aim was to observe how quickly and successfully the team worked their way towards NASA's recommended solution.

Initially, after having read the problem description, a balanced discussion involving all three participants took place. However, after six minutes of the allotted twenty had passed and the first five most important items had been identified, the discussion changed dramatically. The team began to have difficulty in deciding how the remaining items on the list were to be rated, and by the ten-minute mark, one subject had taken the role of a leader whereas another had withdrawn from the discussion.

With five minutes left, the silent member began to contribute again and a more balanced discussion ensued, with voting where necessary, through to completion of the task with thirty seconds to spare.

Although the team's solution was not identical to NASA's, it was very close and acceptable. Pulse rates were found to have increased by eight beats per minute for the two most active subjects, a sizeable increase, probably a reflection of the degree of heated discussion they undertook, and by four beats per minute for the less active one.

All three subjects indicated they enjoyed the task and the environment of close proximity working. The less active subject claimed he had felt overpowered by the personalities of the other two when the discussions ran into disagreement declaring '... they seemed oblivious to my suggestions so I decided to take a back seat role and leave them to argue it out'.

The second experiment was based around a desert survival exercise which again required identification of important items for a team stranded, this time, in the desert. It was devised to ascertain how the three subjects could work together while being isolated from each other and using only electronic mail for communication as in a typical teleworking environment. Subjects worked at networked PCs, each in a separate room so that no visual or verbal communication was possible. A slightly extended time limit of twenty-five minutes was set to allow for the poor performance of the computer network being used.

After reading the problem definition, the subjects started to exchange their initial thoughts via the email system. They soon established the key features of the problem and offered each other suggestions for the items that should rank high in the importance rating. Within eleven minutes they had correctly identified the five most important items. They then moved onto items lower down the list at which point it soon became apparent that they had strongly differing views and some considerable time (eight minutes) was spent with each justifying his own judgement. Eventually one member drew attention to the limited time left, and within the remaining six minutes agreement was finally reached on each item's degree of importance. Apparently this process was aided by the extensive reasoning which had already taken place earlier.

Again, the team was found to have developed a good solution when compared to that of the 'expert'. This time, pulse rates were found to have risen by only two beats per minute for two subjects and by three for the third, a result that suggests the teleworking environment was less stressful, perhaps by being less confrontational. Indeed, no leader emerged throughout this problem solving exercise, and there was generally equal participation. Indeed, the previously less active subject commented that he felt he had had a better opportunity to express his opinions using e-mail.

All three subjects again enjoyed working on the task, but two reported that after the novelty value had worn off they did not like this working environment, one of them stating that he did not like the feeling of being isolated and by himself. The third did not mind the environment but nevertheless did not feel he would wish to work for long periods of time under those conditions.

6. Analysis of Experimental Findings

As far as completing the tasks was concerned, both environments proved to be highly successful in achieving the solving of the problems. The second experiment showed that the teleworking environment facilitated an even distribution of ideas and contributions from all three subjects. Whereas in the round table working a leader

had emerged to dominate the discussion, and one member had become overwhelmed by the force of debate, in the teleworking environment the quieter subject was able to contribute on a more equal basis. This might suggest that the teleworking environment encourages broader, more democratic discussion.

The face-to-face working environment of the first experiment appeared to be more stressful for the participants, although on balance, this was the style of working that the subjects finally felt they marginally preferred.

7. Implications for Tele-Education

The educational systems across the globe are coming under increasing pressure to become more efficient and more flexible to the needs of the learners. In particular, people are increasingly requiring and seeking education or retraining beyond the traditionally assigned ages. Distance education is seen as a possible solution for many of these in that workers can receive in-time training without having to leave work to travel to an educational institution, and foreign students may study in another country without the expense of having to leave their own.

This study coupled with the experimental work suggests that certain guidelines could be proposed in order to increase the success of a transition towards a tele-education environment for students and trainees. For example, the success of an educational homeworking arrangement is largely dependent on the course tutor and the homeworker, and it is therefore important that both are enthusiastic about teleworking, aware of potential benefits and disadvantages, and clear about how the arrangement will operate.

If a tele-education arrangement is to be a success it is important that the potential student has appropriate personal qualities that allow them to work unsupervised or be supervised remotely. These include self-motivation, self-discipline, commitment to learning, adaptability, self-organization, and ability to work with little social contact.

More generally, working, reporting and communication arrangements between the student, tutors and other students will need to be established, as well as any attendance requirements on the part of the student. Ensuring that the student does not become isolated from the educational institution and other students will probably be a priority. The experimental evidence described above provides some anecdotal evidence that collaborative problem-solving, such as often found in group assignment work, can take place adequately or even more effectively using a distance technology such as email. However, occasional attendance at class meetings will go some way towards preventing isolation if this is feasible.

8. Conclusions

The driving forces that have motivated teleworking are unlikely now to be halted. Likewise the pressures on education worldwide are also unlikely to abate in the near future. Against this, the costs of telecommunications are falling, as is the cost of bandwidth hungry technologies such as video-conferencing. These factors are likely to hasten an evolutionary change in working and learning practices as a long-term consequence of the information technology revolution.

However, in both cases, rather than a sudden change, it is more likely that there will be a gradual, evolutionary change in working and learning practices as a long-term consequence of the information technology revolution. In all probability, teleworking will increasingly be absorbed into the mainstream of normal working practice and tele-education gradually phased in for appropriate groups of students. More flexible, location-independent working and study practices will emerge. It will become accepted practice for workers to spend part of their time working outside the traditional office or studying within it.

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Environmental Discovery Online: A Case Study

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The National Wildlife Federation (NWF) has developed an online strategy to provide the K-12 classroom audience environmental education resources and training. Through online programs including an in-depth web page, a monthly list-serv, an annual cyber-festival, and distance learning courses, NWF has combined its decades of experience in delivering high quality environmental education content through the more traditional means of print materials and workshops with a need to reach a broader audience and provide ongoing support for classrooms interested in integrating environmental education into their curriculum.

The goals of NWF's online educational programs are to increase environmental awareness by providing educators the skills and resources they need to complete community-based environmental activities and projects. The programs have been successful: the emphasis is on hands-on learning, the materials are free and can be accessed in many forms at any time, and the use of technology engages students.

Using Web Assignments to Foster Critical Thinking, Communication, and Problem Solving Skills

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Abstract: In an attempt to enhance student responsibility for learning and increased student class participation, the two authors, from the SUNY Cobleskill Social Science Department, have developed an instructional method which utilizes constructionist learning strategies, critical thinking skills and the World Wide Web to evaluate contemporary issues and problems in their respective fields (i.e. psychology and sociology). This instructional method produces different cognitive and affective outcomes for students and increases the level of classroom discussion and student connections between the texts and the material. This presentation will demonstrate how students can learn to think more critically, write more precisely, and learn to solve problems and use the Web to learn research skills.

Based upon the classroom discussions, the evaluation of WWW critical thinking critiques written by students, and instructor observations, we have found that there are educational benefits for using technology as a learning tool. Student classroom participation has increased significantly and student learning appears to have reached a deeper level than found in previous class discussions. We believe that these instructional strategies empower students to take ownership of their learning.

We will show how these strategies can be implemented in any introductory course. Every instructor can expect to get increased participation, enthusiasm and interest from the students in their class utilizing these methods. Each participant will leave with practical suggestions for application in the classroom.

PLATINUM
Worldwide Distributed Courseware Production, Learning and Training using MTS

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Abstract: This paper presents the modular training system MTS, the PLATINUM [1]-Net, a worldwide network for innovative learning and advanced training, and distributed collaborative training on demand as well as cross-media delivery of course material as demanding a p-plication scenarios. The MTS system anticipates tomorrow's learning scenarios by providing flexible, on-demand, user-adaptive, co-operative, telematics-based, distance learning ser v-ices. MTS allows efficient and effective co-authoring of courseware and flexible, persona l-ized, cost-effective learning for users. Based on a flexible modular courseware concept, the MTS fosters the collaboration of multiple authoring teams in the development of global courseware domains.

1. Introduction

Traditional training focuses on teaching in either classroom-like settings at fixed times and places, or in individual learning settings which lack teacher guidance, feedback, and the opportunity to apply the presented information. The upcoming information age demands new training concepts and infrastructures for life-long, high quality training. The learners need to be able to access on-demand and goal-oriented training from their workplace or at home. Training should also be adapted to the individual knowledge and learning style of the user. Even within a high quality learning environment, the human factor will remain vital to allow expert consultation, teacher guidance, and user co-operation.

These environments introduce additional requirements. Training providers need applications by teams of experts, pedagogues and media designers for efficient multimedia courseware production. The accumulation of knowledge in such environments demands efficient management concepts to enable the multiple use of existing courseware.

Computer-based distance learning satisfies this need by providing flexibility with respect to place and time. Today we can identify steps towards integrated solutions based on the Internet which enables access to the learning material independent of the learner's time and place. In contrast to stand-alone learning, distance learning led to a trend to merge the whole world of education into one global network where the learners could study virtually and access innovative multimedia courseware combined with (adapted) traditional learning approaches.

Learning and training can be characterized by four parameters: the *people* executing the learning and training tasks, the *places* where those people act, the *systems* providing the technical infrastructure, and the *knowledgeware* as the underlying courseware material.

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[1] PLATINUM stands for *Presentation, Learning and Training in the Internet using MTS.*

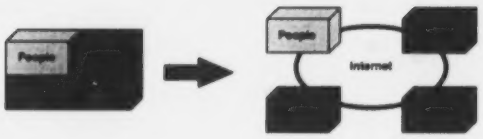

Figure 1: Trends in Internet-based Learning and Training

Nowadays, learning and training systems provide local solutions and are realized as black boxes incorporating all these components. In the Web-based future scenario, all components will be distributed via global networks (Fig. 1).
This paper addresses all the issues above and presents MTS as a substantial step forward towards effective and flexible Internet-based learning and training.

2. Concepts of Internet-based Learning and Training

2.1 Roles involved: *People*

Traditional computer based training (like CD-ROM based CBT) consists of two strictly separated phases: courseware production and courseware delivery. The underlying paradigms are based on the assumption of single authors and single learners not interacting with each other.

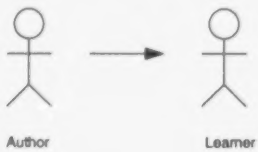

Figure 2: Human Networking in Traditional Computer-based Learning and Training

This situation changes completely in Internet-based learning and training systems. Here, worldwide distributed collaborating *communities* are considered instead of single actors. Cooperative authoring and group learning are obvious usage scenarios in network environments. Moreover, learners can give direct feedback to the authors, which, in return, is leading to shorter courseware innovation cycles.

Besides this, new roles arise which are specific for Internet-based learning and training: online tutoring, information brokering, and knowledge tailoring.

Online consulting describes the concurrent usage of courseware by a teacher and a student, to which both may have different views and access rights to the underlying course. The real advantage of online consulting as compared to traditional educational approaches is the network-presence of tutors: the Internet allows users to find the best-suited tutor worldwide for a specific question.

Internet-based learning and training is based on worldwide distributed knowledge domains (see below). As the available amount of information explodes, the configuration of appropriate individual courseware becomes more and more important. The *knowledge tailor* fills this gap. He serves as a mediator between producers and customers by transforming raw material into high-quality knowledge products.

The *information broker* mediates between supply and demand of knowledge products. As in the brokering of real goods, appropriate brokering becomes important in large-scale markets.

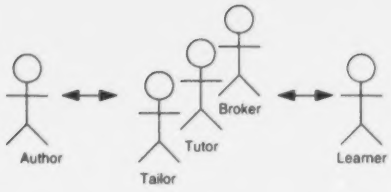

Figure 3: Human Networking in Internet-based Learning and Training

In summary, Internet-based learning and training changes the way we interact with knowledge in two main ways: unidirectional static chains are being replaced by highly interactive networks and many different *knowledge mediators* are arising.

2.2 Learning Environments: *Places*

Traditional learning and training takes place at fixed locations and at predefined times. In stand-alone learning scenarios, the learner works isolated and, in general, using entry-level environments. The available material is restricted, and there is no possibility for tutoring or reflection about the lessons learned.

Electronic classrooms overcome these problems by providing access to multimedia courseware, yet still supporting the learning in groups and the direct interaction with the teacher. Moreover, advanced infrastructures such as collaborative virtual environments allow for new approaches to computer-based education and training.

Web-based learning and training environments go even one step further. Here the notion of *place* makes no sense and is replaced by *ubiquitous computing*, i.e. worldwide transparent access to courseware domains independent of their physical location. Moreover, since in the Internet application logic and access via user interfaces are separated by default, individualized access becomes more prevalent.

2.3 Worldwide distributed *Knowledge Domains*

The creation and usage of Internet-based knowledge differs completely from traditional courseware with respect to the following aspects:

- Use of references instead of copies
- Availability of multi-author domains
- Separation of structure and content
- Provision of data and metadata
- Support of dynamic and active courseware

Internet-based courseware is used *on demand*; it is no longer prefabricated and then delivered. Moreover, a community of users accesses the same courseware material. On the one hand, this facilitates the reflection about the learned knowledge. On the other hand, additional methods for individualizing the common course (e.g., by personal annotations) have to be provided. Moreover, the user has to pay for *usage* instead of *ownership* of courseware.

The Internet provides new means of collaboration. Large courseware domains cannot be provided by single individuals anymore but instead need to be created by teams of authors. Therefore, appropriate mechanisms for collaborative work on courseware domains have to be provided.

The reuse and adaptation of information stored in knowledge domains requires strict *modularization*. Courseware structures incorporating, for example, didactical principles have to be strictly separated from the content used. This separation allows the reuse of already proven material in different contexts or learning scenarios.

Courseware material is always used in certain learning contexts. Therefore, *metadata* describing the semantics of the data in the courseware domain have to be provided. Since a single material can have diverse meanings in different contexts, varying metadata may exist to a single data entry.

The fact that courseware is referenced instead of copied decouples the lifecycle of the courseware and the lifecycle of usage. This enables the usage of *actual information*. Only Internet-based courseware can incorporate actual and dynamically changing information.

2.4 Systems

Traditional courseware systems are based on proprietary authoring environments producing executable course blocks.

Internet-based learning and training systems, however, can be seen from two perspectives: the extension of traditional local authoring systems to the WWW or the availability of learning and training as an application on top of generic Internet-based architectures.

The first approach is pursued by systems like Macromedia [Macromedia 1998] or Toolbook [Asymetrix 1998]. In the first stage, HTML-export was made available to support the delivery via Web-Browsers. Next, server-side administration tools were provided. However, these approaches require proprietary solutions.

The provision of generic learning and training platforms has been undertaken, for example, by the Deutsche Telekom in the Global Learning system [GlobalLearning 1998] and by Oracle's OLA [Oracle 1996]. These architectures focus on the provision of distributed servers providing generic support for user and courseware management. However, the courseware modules still remain proprietary.

The MTS-system combines the strengths of both approaches. Designed on top of a three-tier Web-architecture, it provides both kinds of distributed courseware servers, an innovative courseware concept, as well as support for traditional courseware.

3. The Modular Training System

In this chapter, we describe the Modular Training System MTS as an example of an Internet-based learning and training architecture. We will explain what solutions the MTS system provides to the challenges of Internet-based learning and training as mentioned above.

3.1 Architecture of the MTS

The MTS System is based on a state-of-the-art, three-tier WWW architecture, encompassing a client layer, an application server layer, and a remote resource layer (Fig. 4).

The *Client Layer* contains the WWW browser and the MTS client. It defines the top level of a virtual learning environment and offers graphical user interfaces to the learner. While the WWW browser is used for the presentation and interaction of the course material, the MTS client is implemented as a Java-based extension (plug-in). The MTS client supports functionality such as graphical authoring and interactive group management. As an add-on to the WWW client, the MTS client is implemented with Java to complete the learning environment, e.g., to start the video-conferencing software to support the online tutoring.

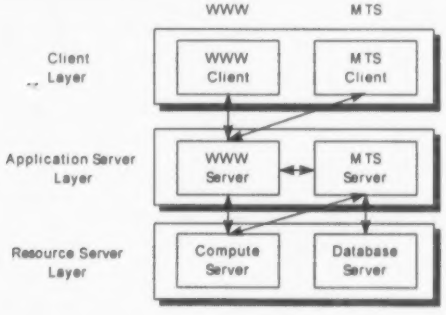

Figure 4: Architecture of the MTS System

The *Application Layer* contains the WWW server and the MTS server (CBT server). While the WWW server provides the standard components for the network connection between client and server side, the MTS server contains the application logic to steer learning and training sessions. This mainly encompasses the course control, but also includes components for session management and group work.

The *Resource Layer* consists of database and compute servers. A database server contains material and user data, and a compute server executes applications (simulations and microworlds) to effectively support training applications. Both the database as well as the compute servers can be distributed themselves.

3.2 The MTS Server

3.2.1 Overview

The MTS server is a CBT server, which communicates on the one hand with the WWW server to exchange the WWW-based information and, on the other hand, with the database server to get and store the course material and user data. The user sends requests through the WWW browser to the WWW server using the HTTP protocol. The WWW server redirects this request to the MTS server via a CGI program. The MTS server preserves the different information from permanent user data to user interaction, from course contents to individual course flow, and exchanges this information with the MTS database.

Every request from a client can be identified through the 'cookies' mechanism. The behavior of learners will be stored in the user profile. During the operation of a client request the user profile is used to determine the course flow individually for every user. The fixed 'links' of normal WWW documents are replaced by the flexible course structure, considering the interactions made by users, as well as the users' knowledge states.

The compute server is connected by CGI calls, if a course unit contains such requests. The results from a compute server, such as graphical images or video stream, are sent back to the WWW server and presented in the course online. The other possibility for connecting the compute server is the IIOP (Internet Inter-ORB Protocol) architecture. *Figure 5* shows an exploration unit which calls a ray-tracing teleservice with different parameters to get the illumination effects online.

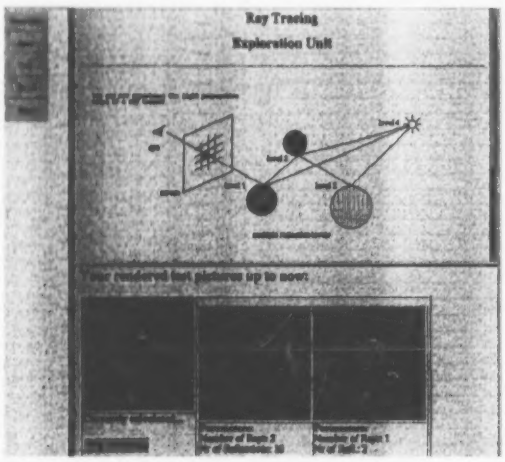

Figure 5: Exploration Unit Using a Remote Compute Server

3.2.2 Login and Session Creation

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The user of the MTS system always starts with a login message. This message identifies the user and its role: administrator, author or learner. The session management handler checks the input with user data stored in the user database. Dependent on the role, the executive then creates a new instance of the course runtime handler or the course-authoring handler. Next, a session ID is created which uniquely identifies this session. The executive uses this ID for passing further requests. The session ID is passed back to the WWW client using the 'cookies' mechanism. This returns a unique identification of the WWW client to the MTS server. The according handlers then process all subsequent requests.

3.2.3 Course Authoring

In authoring mode, the authors first select a course, then the authoring environment is started and the authoring client, implemented in Java, is downloaded. This tool supports the interactive graphical design of course nodes and units, while standard editors are used to produce course material. In authoring mode, both virtual and direct references can be created. The authoring clients send messages describing the creation, modification and deletion of nodes and units. These messages are passed via the executive to the course-authoring handler. The authoring handler then uses the mapper for mapping virtual references onto direct references and calls the component management services for accessing the database.

The author can preview the course using the course runtime handler.

3.2.4 Course Runtime Handler

The course runtime handler is used either in learner mode or in authoring preview mode. The user starts the course runtime handler when selecting a course node. This node is loaded and the course runtime handler executes it by interpreting the CDL script.

The course runtime handler distinguishes between virtual and direct references, and between references to nodes and references to units. All virtual references are passed over to the mapper service, which returns a set of direct references. Next, direct references to units are passed to the converter which, by means of the component management service, returns an HTML page. Direct references to nodes are accessed directly via the component management service. This node is then interpreted directly in a recursive manner.

The actual course component (node or unit) may return a value via a Java applet. This value is passed via the executive to the course runtime handler, which updates the user profile and, based on the actual value of the user profile, determines the next course component to execute.

3.2.5 Group Management

The group management functionality is available after a user is logged in, yet it is independent from the actual session management. A user can watch active user groups, join user groups, and communicate with other users, such as via email. Moreover, synchronous communication and teletutoring are supported.

3.3 Personalities

The MTS integrates course presentation, course production, and administration into a single system using three different operation modes: the course runtime handler mode, the course authoring mode, and the administration mode. These operation modes are used by the different kinds of users, such as learner, author and administrator, to support the different kinds of MTS usage. "Authors" will typically be teams of specialists (educators, scientists, programmers, and media designers) which all have their dedicated tasks. In the course runtime handler mode and the course authoring mode the users use the remote client to connect to the LTC, while in the administration mode the LTC administrator uses the administration tool locally to manage the course configuration and the user data stored in the MTS database. For the different kinds of usage, the MTS

offers the responsible modules and tools, both at the client site and the LTC site, which are integrated smoothly to a complete MTS system.

3.4 Learning and Training Centers

The integration of various learning aspects is the goal of the Modular Training System (MTS). From the users' point of view, the MTS is like a virtual classroom or virtual training center which offers a complete multimedia distance learning environment including course presentation, course production, user and course administration, group learning, and online tutoring (Fig. 5).

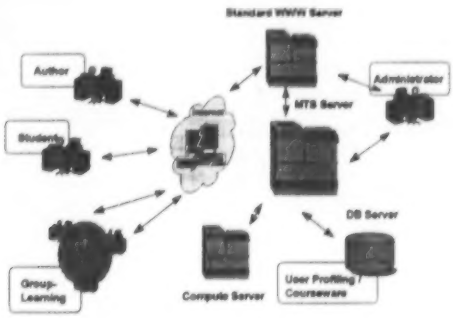

Figure 6: Learning and Training Environments

Learning and training takes place in MTS according to the following model. First, two main types of sites should be distinguished: the Learning and Training Center (LTC) and the user's workplace.

Learning and Training Centers are composed of a standard WWW server, a MTS server, and a MTS database server, and provide management functionality for distributed courseware and administration functionality for users. The LTC is the central infrastructure element since it is the access point to all training facilities. Each LTC offers its training facilities to registered users. It administrates access rights to courseware, assigns experts for consultation, and aids the formation of virtual learning groups. The LTC is responsible for guaranteeing the quality of new courseware made available to the entire Virtual LTCs by their local authors, and it is the owner of a distinct subset of the distributed courseware domain.

On the client site, the main components of the MTS are the WWW browser and its add-ons. The client runs a course front-end at the trainee's and author's workplaces. It handles the user's input and edits, downloads, and displays the course framework and the different kinds of courseware material.

Since the material is stored in the Learning and Training Center, each LTC must run a WWW server to connect the WWW client. The MTS server provides all the necessary functionality to control the course, and the database provides the multimedia courseware and user information.

LTCs are interconnected via terrestrial and satellite links to form a global Virtual LTC that provides transparent access to all courseware for users from arbitrary locations with different networking bandwidth and client configurations

3.5 MTS-Courseware Concepts

MTS strictly applies the paradigms of modularity and reusability to courseware. This leads to two design concepts: a modularity concept composing courses out of different, clearly separated components, and the strict separation of the content of these components from their description using metadata.

3.5.1 Structuring Courseware

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Courseware is broken down into three different categories: course nodes, course units, and course material. These categories form a hierarchy of abstraction and support the design of modular and flexible courseware (Fig. 7):

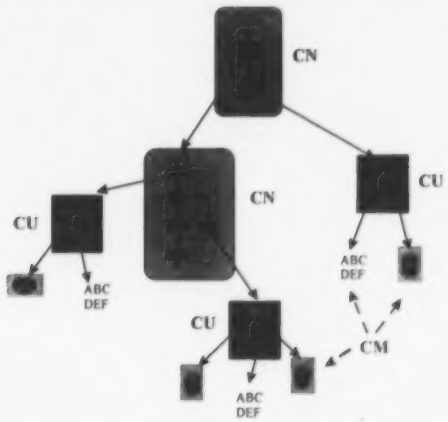

Figure 7: Modular Structure of Courseware

Course Nodes define learning goals. A course node does not contain any information about *how* this learning goal can be reached. Courses are arranged as networks. Each course unit delivers a return value indicating the learner's success. Dependent on this value, the appropriate "next" course node can be chosen. Herewith, a complete course can be described on an abstract level. The content of a course node is a script in the special language CDL (course definition language). This script describes the implementation of the course node and may reference either other nodes or units. It never references material herewith supporting the clear separation of structure and content.

Course Units are implementations of specific steps in the learning and training process. Course units may either be presentation units, exploration units or test units. Each of these unit types can be implemented using characteristic templates. Course units are self-contained. They contain only references to course material, but neither reference other units nor nodes. In this sense, course units form containers of course material. They are implemented as an extension of HTML, the so-called HTML-M (for MTS-HTML). This extension includes special tags for referencing (see 4.2). Course Units deliver a return value indicating the learner's success when traversing this unit.

Course Material describes the material used in the course units and, herewith, the visible parts of a course. The course material consists of Internet standard formats like Text, Audio, and Video.

In order to enable reuse and multiple use of courseware on a large-scale, each module is stored as a separate entity, is self-contained and implements a common interface. This also allows course adaptation to the individual needs of the trainee by using the best fitting modules.

The flexible linking between the course documents requests the separation of the course framework and the course contents. The MTS server controls the structure of the course, independent of the WWW documents, which represent the course content. This allows the reuse of the course material in different courses. For a special user group, the course can be produced with a special course framework, yet can reuse the course material available. In this context, the database server plays an important role: In order to use the existing course contents the domain must be efficiently browsed to retrieve the suitable material. For this domain browsing, the self-description of material and catalogues must be stored in the MTS distributed multimedia database.

3.5.2 Referencing of Courseware

An orthogonal concept of the MTS courseware is the *referencing* of courseware. The different courseware components introduced in section 4.1 are never embedded directly, but are always referenced instead. Moreover, to every courseware component there exists a separate *description* containing metadata of this component

in the form of characteristic attributes. Even more, constraints on the attribute—value pairs—can be defined. Herewith, the following hierarchy of references exists in the MTS system:

- direct references, pointing to a course component's data and metadata directly
- virtual references, describing a constraint set of direct references

While a direct reference points to single component, a virtual reference defines an open set of characteristics and, therefore, of course components.

This design principle allows the concept of *late binding* to be introduced in courseware. While a direct reference is bound at authoring time, virtual references are late bound. They either can be bound at a special configuration step before course delivery, or they can be bound at runtime. The binding at runtime allows users to choose the best-fit course component depending on their learning progress.

4. Applications and Demonstrations

4.1 Usage of MTS in Learning and Training Projects

The MTS system has been developed, enhanced, and demonstrated in large-scale projects in Germany (COBRA-3) and on a European scale (IDEALS).

4.1.1 COBRA-3

In the COBRA-3 project [Borgmeier et al. 1996] sponsored by the Deutsche Telekom, the MTS-system has been used as basis for the development of advanced courseware by Fraunhofer institutes to teach employees in small and medium-sized enterprises. Courseware in such different areas as logistics, development of ASICs, and introduction into CAD systems has been developed and taught in Germany via ISDN-networks.

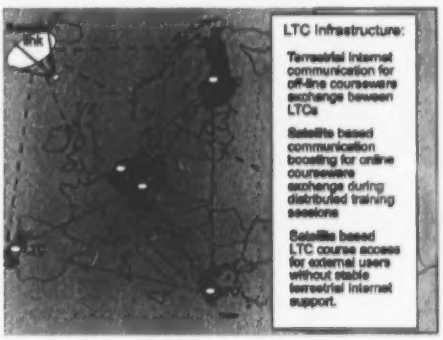
LTC Infrastructure:
Terrestrial Internet communication for off-line courseware exchange beween LTCs
Satellite based communication boosting for online courseware exchange during distributed training sessions
Satellite based LTC course access for external users without stable terrestrial Internet support.

Figure 8: The IDEALS Network

4.1.2 IDEALS

In the IDEALS project [Borgmeier & Beyer 1996] sponsored by the EU Telematics Application Program, a European-wide network of LTCs has been installed demonstrating different usage scenarios in small and medium-sized enterprises as well as in institutes of higher education (Fig. 8). The university pilot is the basis for the Computer Graphics courseware domain[2] [IDEALS 1997].

[2] The available courses can be executed on the TUD LTC at URL http://ltc.gris.informatik.tu-darmstadt.de/.

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4.2 The PLATINUM Network

Based on the experiences gathered in these projects, the PLATINUM network is currently set up. It connects the different branches of the INI-GraphicsNet[3] and, herewith, defines a worldwide network of excellence in learning and training in all areas of computer graphics (Fig. 9). The different branches are connected via high-performance networks (ATM, satellites) and provide state of the art learning facilities such as collaborative virtual environments.

Figure 9: The PLATINUM Network

PLATINUM forms a global learning and training network and will serve as a common platform for the development of different kinds of demonstrators in areas like training on demand, collaborative simulation of complex technical systems, teaching and tutoring at universities, or qualification for workers in industry.

4.3 Cross-media Delivery of Educational Material: A PLATINUM scenario

Within the CAMPuS (Cross Application and Media Publishing Services) project, Fraunhofer CRCG targets the unification of two of its R&D areas—Cross-Media Publishing (CMP) and Distance Education: While CMP is targeting the preservation of concepts throughout the distribution of information using diverse publication media, efficient distance education faces a rather different task. It has to reuse information entities for different educational purposes and audiences (applications), such as for entry-level education, advanced training on the job, or even high-level overview presentations. Obviously, each of these applications puts different demands on the underlying media, yet they can also be used for non-educational publication purposes. On the other hand, CMP needs to consider various publication purposes as well. Therefore, the exploitation and development of MTS as a platform that supports the integration of, and common R&D for both areas, provides a promising approach to support a variety of applications and customers. In this sense and supplementing the Computer Graphics courseware domain mentioned above [Klein & Encarnação 1997], Fraunhofer CRCG's distance education efforts additionally include cooperation with the Computer Graphics Lab at Brown University, the Computer Algebra group of the University of Rhode Island, the Rhode Island School of Design (RISD), and Bryant College. Furthermore, in cooperation with RISD and the Distributed Publishing Lab—an international collaboration of institutions from Germany, the US, Portugal, and South-East Asia focusing on CMP over high-speed global networks for business, scientific, and educational purposes—Fraunhofer CRCG has established a Lab for Cross Media Publishing in which the CAMPuS project is pursued.

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[3] International Network of Institutions for advanced education, training and R&D in Computer Graphics technology, systems and applications.

5. Future Work

The current MTS system is based on currently established Web-technologies. The server side is implemented mainly in C++, while the clients use Java and Javascript. A future version of the MTS system will be based entirely on Java and will use advanced techniques, such as RMI, JavaBeans, and EnterpriseJavaBeans. Herewith, a better distributability and scalability of the system will be reached.

Another focus of future research is the sophistication of user-adaptation mechanisms in MTS. A few adaptive, Web-based educational systems demonstrate the possibility to use adaptation technologies from the area of adaptive hypermedia in the Web context. Two of these systems, InterBook [Brusilovsky & Schwarz 1997], developed at Carnegie Mellon University (CMU), and ORIMUHS [Encarnação 1997], developed at the University of Tübingen, Germany, provide particularly suitable approaches towards developing adaptive interface technology for Web-based courseware. InterBook's strengths lie in its embedded adaptive navigation support (ANS) rather than its sophisticated user-modeling. ORIMUHS qualifies through its history-based user-evaluation mechanisms, although it focuses on adaptive presentation rather than guidance. Both systems have been investigated in laboratory settings and have demonstrated encouraging results. The challenge is to combine and further develop these promising approaches within the PLATINUM framework in the context of real-world, Web-based university courses. This research has already been targeted by Fraunhofer CRCG and CMU's Computer Science department in the form of a joint proposal to the National Science Foundation.

On October 16, 1998, the PLATINUM Network will hold an international workshop on I*net-based Life-long Learning involving all of its geographically distributed sites. Throughout this workshop, the participating groups will show MTS-demonstrations from various application areas and fields.

6. Conclusions

Internet-based learning and training will not replace the traditional approach to learning abruptly, rather it will have to prove its advantages over the traditional forms. It is expected that it will become an indispensable supplement for life-long high quality training soon. The multimedia distance learning system MTS concatenated the up-to-date CBT features to the Internet to satisfy the important pedagogical and didactic demands with its concepts of multi- and reusability, modularity, and adaptability. MTS is open for new media types and running in a heterogeneous computer environment. Its modular, scaleable, open system architecture is designed to support reuse of courseware and to meet the challenges of global, life-long learning for the future.

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Generating Hypermedia Applications for Volatile Database Output

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Abstract: This paper reports on work in progress on the generation of hypermedia (Web) presentations for the results of arbitrary queries to multimedia databases. In [Houben & De Bra 1997] we have proposed a heuristic algorithm for generating navigation structures for multimedia database output, based on ideas from RMM [see Isakowitz et al. 1995]. We have shown that only part of the RMM design methodology can be automated deterministically, and have provided both heuristics and a way to override them through additional specifications in a database query. This paper describes our approach to automatically generate a presentation for multimedia database output, in addition to the generation of navigation for such output described in [Houben & De Bra 1997].

1. Introduction

In [Houben & De Bra 1997] we have shown an approach to generating World Wide Web applications for volatile database output. The motivation for this approach is that the use of a hypermedia platform such as World Wide Web can help to represent the less structured and not purely textual information one typically finds in applications such as employee databases, museum databases, geographic information systems, and mail-order catalogs and services.

Since the design and construction of a hypermedia application involves the representation of relationships between information objects, the approach for generating the *navigation structure* is based on the ideas of RMM [see Isakowitz et al. 1995]. RMM combines elements from the Entity-Relationship model [see Elmasri & Navate 1990] and HDM [see Garzotto et al. 1991] to effectively manage relationships between objects. The core of our approach is to use as much as possible the relevant aspects that are embedded in the data definition (of the volatile information) and in the query specification. In [Houben & De Bra 1997] we have shown how we can deduce the navigation structure for the hypermedia application from the data definition and query specification.

The subject of this paper is the generation of the *presentation* (through WWW browsers) of volatile database output. This includes the presentation of the records (from the query result) and the presentation of the relationships with other records. The information contained in a query result generally depends on the data structures underlying the volatile information, and on the given query specification. We have shown that RMM and its supporting tool RMCase [see Díaz et al. 1995] do not help in the case of results of arbitrary queries. The main problem is that the dynamically generated structure of a query result cannot be (trivially) translated into a hypermedia presentation.

2. Record Presentation

Based on the concepts of RMM, the lowest level of representation of information is the level of the *slices*. Just like a pizza may be too large to eat all at once, an object may be too large to present all at once. It is therefore divided into slices, which are essentially groups of attributes that belong together (semantically). This grouping is used to divide a record into information chunks that can be elegantly displayed by a World Wide Web browser, without too much information becoming "invisible" due to a lack of space on the screen.

It is obvious that a designer of a hypermedia application would specify the presentation of all slices explicitly contained in the data structures. In order to do so, our approach asks the designer to do two things:

1. *Attribute presentations* are chosen for every attribute contained in the slice.
2. A *slice presentation* is constructed using the chosen attribute presentations.

We assume that the attribute presentations are specified in a way that enables the layout algorithm to measure or estimate what (size) rectangular screen area is needed for an attribute. The presentation of a slice can be

encoded in HTML using tables. However, such an encoding does not specify what the relationship is between attributes, and thus what the possible reasons are for positioning attributes the way they are. Therefore, we propose to generate the HTML code from an internal representation which specifies *relative* positions of attributes. For instance, we can specify that a "subtitle" attribute must be positioned under a "photo" attribute (and that it must be centered under the photo), and that a "description" attribute must be positioned to the right of the "photo". A translator script will combine size information and these positioning constraints into a layout that is then converted to HTML code.

Both size information and positioning constraints may be hard or soft. An image may have a fixed size and the subtitle really must be positioned immediately under the image. But a text paragraph may be presented in a wider or narrower column and if there is no room we may allow the description to be positioned under the image and subtitle. See [Borning et al. 1997] for the use of constraints for automatic user-interface layout generation.

Another issue involved in the attribute presentation is the choice and presentation of index attributes that are used to provide navigation to slices. We propose to provide two presentations for index attributes:

- a *compact* presentation used to help the user in identifying the records he is searching for;
- a *complete* presentation used to supply the user with all the information available on the selected record.

These two types of presentations can be used to handle different sizes of query results. Our typical target user wants to obtain an efficiently "browsable" set of records. Using the compact attribute presentations first, it becomes efficiently possible to identify the records that are (potentially) interesting. Asking for the complete presentation for those records makes a subsequent thorough inspection of the information possible.

3. Relationship Presentation

In [Houben & De Bra 1997] we have defined the generation of access structures for a query result. This includes the definition of record relating structures (index, guided tour, indexed guided tour or grouping) and the relationships between slices. It did not include any specification of how these relationships are represented.

In some situations the user asks for information that is represented by slices involved in multiple relationships. For example, the representation of a "multiple join" means in general that a slice can give access to other slices contained in multiple guided tours. For the presentation to the user it is essential that the presentation of the navigation and the presentation of the actual record contents are generated simultaneously because both parts of the presentation share (fight for) the same screen real-estate.

We have therefore augmented our approach with practical guidelines to specify how navigation and actual contents are displayed together. The basic idea is that the designer specifies:

1. How the browser page is divided in different frames for navigation and contents;
2. Which navigation information is displayed (not all navigation information is accessible at all time);
3. How this navigation information is displayed.

The presentation of new slices must always be *generated*, when we deal with new slices (parts of existing slices or combinations of existing slices). Sometimes, the presentation of access structures can be *designed*, whenever we can use presentation aspects defined for existing slices. For instance, if a query results in a single indexed guided tour through a set of new slices, the page layout for that result can probably be the same as that for single indexed guided tours through a set of existing slices. But for complicated multiple joins generation of the presentation of the navigation structure may still be needed.

4. Conclusion

In this paper we have discussed two important aspects extending our approach. The first aspect is the attribute presentation and the composition of attribute presentations into record (or slice) presentations. We have shown what elements need to be added to the approach to facilitate the proper design of applications for ad hoc query results. The second aspect is the presentation of relationships that represent navigation mechanisms. We have shown how the designer can fix a number of details in order to produce an effective application. The presentation of navigation structures is more an issue of design than of automatic generation.

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Development and formative evaluation of an instructional simulation for a web-aided meteorology course

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Abstract

The purpose of this research was to study the effects of selected characteristics of a Java simulation on students' conceptual development, problem solving and transfer. A two-pronged research study was conducted using students enrolled in a beginning meteorology course at Iowa State University.

For the experimental design, the performances of three groups were compared on posttest scores and a weather forecasting activity. No statistically significant differences were found between the groups on these measures. However, follow-up interview data obtained from five diverse students in the treatment group supported the design and future use of the simulation. Although multiple representations were used by the students to construct knowledge, of the five students interviewed, only one had used an effective problem solving strategy. This student also demonstrated a better understanding of how to transfer newly gained knowledge to weather forecast exercises. Four of the five students interviewed saw the task as being authentic.

Introduction

Theoretically, computer-based simulations are very powerful learning aids. They can improve motivation and enhance learning by providing students with an appropriate cognitive and affective context for learning (de Jong, 1991; Snir et al., 1995; Kaput, 1995). Since computer-based simulations emerge from authentic tasks, they can engage the learners in meaningful, problem-based thinking (Jonassen, 1996). Yet, the research on computer-based simulations is inconclusive. Much is still to be learned about their design and use. Strategies for helping students construct knowledge from the simulated environment are in need of development and evaluation.

This study serves as a preliminary investigation of one Internet-accessible simulation. The purpose of the study was to address the impact of the simulation on students' actions and problem-solving strategies. For this research, an Internet-accessible simulation was developed using Java and HTML. In order to analyze students' learning patterns, students' actions with the simulation were recorded through a web management system, called ClassNet.

Simulation

The simulation (MtnSim) modeled the adiabatic process of an air mass passing over a mountain. Students could set the initial values of temperature and vapor pressure of the air with the goal of causing precipitation at a specified altitude. When set in motion, the simulation animated the air movement and any precipitation that occurred. Two graphs were also displayed. One graph plotted temperature and vapor pressure for the air movement and the other showed temperature and altitude (See Figure 1). A deep understanding of the process involved the ability to cause precipitation at a specified altitude and to interpret and use the graphical representations.

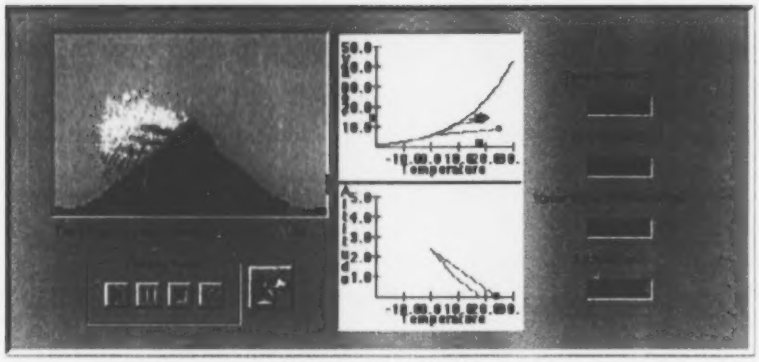

Figure 1: The MtnSim Simulation

Research Design

This study used Web courseware as learning materials. de Dinan and van Shaik (1993) suggest courseware include the following elements: textual material, simulation models, exercises, problems, and feedback information. In this study, the Web courseware was integrated into a traditional course. It included a simulation model (MtnSim), a real-time weather forecast exercise and a Web management system (ClassNet). Textual materials and feedback were the responsibility of the instructor. This Web courseware created an exploratory environment for students.

Students enrolled in a beginning meteorology course were assigned to three experimental groups. Student performance on a five item pretest was used to determine strata and an equal number of students from each strata were randomly assigned to each group. One group was designated the control group and the other two were with-log and without-log treatment groups. The control group did not use the simulation. The with-log group used a version of the simulation that recorded and displayed on demand a history of the trials and results while the without-log group used the simulation but did not have access to the reporting feature (See Figure 2).

Experimental Results

Init. Temp(C)	Init. Vapor Pressure(mb)	Init. Td(C)	Cloud Base(km)	Final Temp(C)	Final Td(C)	Final Vapor Pressure(mb)
25.0	6.88	1.87	Clear	26.07	1.88	6.97
11.82	6.88	1.87	1.28	17.16	-2.89	4.92
15.46	10.63	8.07	0.96	22.07	2.2	7.14

Figure 2: Example Experimental Results Log

Two methods were used in this research, experimental and interview. All groups made assigned weather forecasts, attended the same lectures, and completed the same posttest. In addition, the experimental groups used the simulation of adiabatic phenomena. Based on their simulation performance, the researcher further divided subjects in the with-log group into five subgroups based on their problem-solving patterns (Goos & Galbraith, 1996) and their degree of success in working with the simulation. One student from each group was randomly selected and interviewed. This method of selection identified a very diverse group of students and provided multiple perspectives of the simulation and its value. The student's protocols in using the simulation were used as a memory aid in helping them respond to the prepared questions.

Results

For the comparison of students' conceptual development, it was hypothesized that the groups using the simulation would score significantly better on the posttest. There was no significant difference among the groups in overall posttest

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scores ($F=1.32$, $P < 0.27$). Detailed analysis revealed a statistically significant difference on only one item of the posttest ($F=5.54$, $P < 0.01$). That item was directly related to the simulated phenomena but did not appear to be more closely related than other non-significant items.

For the comparison of students' transfer ability, it was hypothesized that students using the simulation would be more successful in making weather forecasts where the simulated principle was applicable. On all measures the groups experiencing the simulation had a higher mean score than did the control group, but there was no statistical significance on the scores of weather forecasting ($F= 1.44$, $P < 0.25$ for the adiabatic warming case and $F=2.80$, $P < 0.07$ for adiabatic cooling cases).

Overall, the results did not show any significant difference between experimental groups on scores from a posttest and weather forecast exercises. The posttest results are not surprising, based on previous research (Thomas & Hooper, 1991; Upah & Thomas,1993), but the lack of a significance in forecasting is inconsistent. Failure to observe significant differences on this measure may be due to the complexity of the forecasting process and the numerous extraneous factors, such as wind direction, which must be considered.

Interview data was more revealing, showing how the simulation design impacted students' learning with the simulation. Multiple representations, (digital display, animation and graphical), effected learners in two ways: allowing them to construct knowledge across representations and to choose their own mode of representation to explore the simulation. For the student who was able to readily take advantage of the information contained in the log and graphs, the simulation exercises were quickly completed and a sufficient understanding of the concept was developed to transfer the newly-gained knowledge to a new situation. For others the simulation was less effective. For example, four of the five interviewees reviewed the logged histories of simulation activities to determine if they had reached the goals of the exercises, but they did not use this feature as a tool for reflection on their actions.

Student difficulties in interpreting graphs were documented by Leinhardt et al. (1990) and McDermott et al. (1987). Three of the five interviewees in this study had difficulty understanding the meaning of graphs. As a result, they ignored this information and chose either digital displays or animation to explain the phenomena in the simulation. Thus, multiple representations in the simulation provided options for students to choose that built on their previous knowledge but these options also provided an escape from learning new and important tools.

The analysis of the interviewees' problem-solving episodes showed that only one interviewee's protocol showed the features of the three stages of problem solving defined by Goos and Galbraith (1996): "Careless Grabbing of Information and Data Analysis (CGI)", "Exploration Episode (EE)", and "An Orderly Progression of Activity (OPA)". He had reached the last stage of problem solving: using an orderly progression of activity for finding a successful solution. After trail and error, this interviewee tested his plan, searched information, analyzed relevant data, verified his answers, and found a successful solution. Then, he described how he used the logical structures that he discovered in the simulation, such as the wind direction and the location of cloud formation, to forecast the weather in a mountain area. Two other students were poised for improvement, having the basic strategy but needing refinement. The other two students were in serious need of basic instruction and guidance.

Conclusion

The major success of this project was not in improving student's learning as was expected, but in revealing the enormous deficiencies in the students learning skills. More than half of the students failed to employ the most basic tools and strategies for learning elementary science. Thus, supplementary methods must be devised which will support the cognitive and metacognitive development of a very diverse learner population. Perkins (1992) noted that meeting the learning needs of individual students is the job of the constructivist teacher using technology and Vosniadou (1992) advised promoting problem-solving and conceptual change required taking into account the learner and the learning process. From these perspectives, the simulation with authentic tasks and recording facilities can serve as a valuable learning environment for students to develop and improve their learning strategies and for instructors to observe and support that development. However, considerable research on classroom integration is needed before this goal will be reached.

For future research, the MtnSim simulation appears to be a good model. It contains multiple tools of the discipline which students must use to achieve success and it records their actions for further study. In addition, it is an authentic model of an important, complex, and difficult to understand process. In using the simulation, students must be mentally active, focusing on factors basic to the discipline, as they manipulate the model to achieve the desired state. Using this rich

environment, constructivist teachers should be able to take the next step of developing appropriate supporting strategies to aid student's in constructing their knowledge.

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The Development of an Exploratory Simulation for Constructivist Learning: An Example of Java Application

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Abstract

A new simulation (MtnSim) was developed by merging constructivism and technology to create a learner-centered environment. MtnSim was written using Java and put on the World Wide Web for students' use. With the features of embedding an authentic situation, providing multiple-linked representations and displaying input-output data, MtnSim can be used as an interactive environment conducive to fostering conceptual understanding of the meteorological concepts of condensation and adiabatic processes, and the development of problem-solving skills.

Introduction

Recent developments in computer technology are providing new support to the learning environment (Wilson, 1995). These developments make complex human-machine interaction and multimedia products possible and powerful and make accessing structured information sources much easier. The wide range of delivery and access methods accommodate a myriad of learning styles so teachers can use computers to create learning environments for different students' needs.

Computer based applications must not be restricted to the delivery of educational content. They must also be grounded in some model of learning. In contemporary theories of learning and instruction, learners act as active agents in the learning process. From the constructivist perspective, technology should be used to deliver computer based applications emerging from authentic tasks with multiple representations in order to engage students in exploratory learning (Collins, Brown & Newman, 1990; Roblyer, Edwards, & Havriluk, 1997). Constructivist learning benefits from support provided by computer applications because the complexity of world situations can be presented in a flexible and versatile format to accommodate the diverse individualized processes of constructing knowledge.

One promising environment for constructivist learning is computer simulations. In order to promote learners' cognitive processes, simulations need to be designed to engage them in meaningful, problem-based thinking so learners can understand the role that hypothesis testing plays in knowledge generation. In other words, simulations not only need to allow learners to construct and manipulate screen "objects" for exploring underlying concepts, they also need to provide learners with the observation and manipulation tools necessary for exploring and testing hypotheses (Jonassen, 1996). The purpose of this study was to investigate design features which may support specific pedagogical strategies for constructivist learning and cultivate the development of thinking skills. To accomplice this goal, a computer simulation (MtnSim) was developed for fostering conceptual understanding of the meteorological concepts of condensation and adiabatic processes.

Design Features of Exploratory Computer Simulations

Thomas and Hooper (1992) stated: "A computer based instructional simulation is a computer program containing a manipulatable model of a real or theoretical system." (p. 498). Simulation differs from a flexible tutorial environment in that instructional simulation does not provide explicit feedback, but alters the state of the model in response to students' actions in accordance with rules governing the simulated system. This definition of simulation by Thomas and Hooper is used in this paper.

The features proposed in this paper for simulation design integrate learning theories and design techniques for the purpose of meeting learners' needs in constructing understanding. A computer-based simulation with realistic (authentic) situations, multiple representations, and the capability of reviewing previous actions, aids learners in constructing their own

knowledge and cultivating their problem-solving skills. Additionally, by recording the students' actions while trying to solve problems, much information about the students' thinking can be obtained (Smith et al., 1993). This also provides an opportunity for students to analyze and reflect on their thinking. Simulations with a recording function display input-output data and replay the sequence of students' trials so students can review their actions and alter the problem-solving strategy or try another approach when difficulties are encountered. Metacogition.can be fostered when a student is engaged in a learning environment where hypothesis testing is facilitated and reflective thinking is encouraged.

An Example of Exploratory Computer Simulation: MtnSim

By using the MtnSim simulation (see Figure 1), students can explore the various physical characteristics of air that has been lifted over a mountain. When MtnSim is executed, digital displays and graphs provide immediate, visual feedback of the current state of the simulation. Students can directly manipulate initial conditions and immediately see the impact. This interactivity may provide opportunities for students to modify their mental models, by comparing the outputs of the model with their expectations (Jackson et al., 1996). This interactivity is intended to engage and motivate students to explore and couple actions with effects which will lead to understanding.

As an added feature, MtnSim provides the actual sounds of wind and thunder to evoke the learners' stimuli of perception. This may motivate learners to engage in extended exploration of this simulation. The special function of displaying summaries in MtnSim is designed to help learners recognize the relationship between input-output and improve their problem-solving methods by reflection on previous trials.

As the students work through MtnSim, their actions are recorded and made available for researchers. The program is used to track learners' progress and to identify patterns of success and failure in selected learning activities. This method of data collection also provides a window for instructors to determine student learning processes. Based on an understanding of student action in using a simulation, instructors can select appropriate instructional activities to anchor student learning, facilitate the development of problem-solving skills, and make links to related knowledge for the further transfer of concepts learned from the simulation.

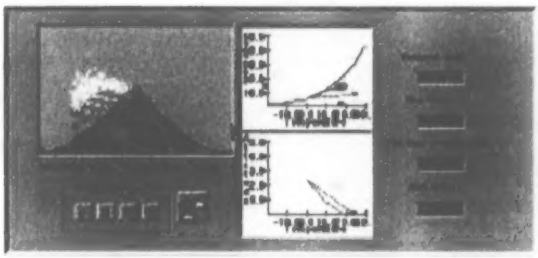

Figure 1: The MtnSim Simulation

Conclusion

The strength of a simulation is to force students to retrieve or discover relevant knowledge, experiences and problem-solving skills under authentic situations. Exploratory simulations require students to take more responsibility in learning processes (de Jong & Njoo, 1992; Thomas & Hooper, 1992). Active learners are most likely to benefit from this kind of use of computer-based simulation. For non-engaged learners, it is suggested this kind of simulation be used in small groups. Through cooperative learning and social interaction, some students will overcome difficulties which occur when they use simulation by themselves. The features proposed in this paper for simulation design integrate learning theories and design techniques for the purpose of meeting learners' needs in constructing understanding. In the future, appropriate learning activities need to be integrated into these exploratory simulations so that optimal learning will occur.

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Reconceptualizing the Use of the Internet in Teaching Middle School Science

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Proponents of educational applications of the Internet portray Internet technology as the key resource to reinventing K-12 education Jackson et al., 1997). For these teachers and researchers, the Internet is the "information superhighway" that provides a gateway to the world's largest library. This enthusiasm for educational applications of the Internet, however, is far from universal. For if the Internet is to be regarded as the world's largest library, it must also be r3ecognized as the world's messiest library. Classroom applications of the Internet are widely recognized as problematic for two reasons. First, open-ended Internet searchers often turn into wastes of instructional time. Second, and of greater concern, classroom applications entail risks that students might access inappropriate materials—such as "adult' sites with sexually explicit content (Jackson et al., 1997).

A curious presumption permeates this debate. Nearly all of the concerns about classroom application of Internet technology are predicated on the unfounded assumption that the Internet will be used by students and teachers to simply search for or look up information. Essentially the Internet is regarded as a high-tech and expensive encyclopedia. The Internet can be put to much more powerful and substantially less problematic uses in today's classrooms. We propose three strategies for using the Internet that provide alternatives to merely "web surfing":

- Using the Internet on a daily basis as an electronic newspaper;
- Involving students in Internet-supported instructional projects, and
- Taking students on cyber space field trips.

Each of these strategies taps into different strengths of the Internet as an information delivery system. First, through daily activities, students learn how the Internet can help them be informed citizens in an age of information explosion. Knowledge bases are changing and growing rapidly; students need to learn how to stay up-to-date if they are to be "informed citizens." The daily exercises described here address this need through activities that tap into the Internet's strengths of (1) providing up-to-date information and (2) providing easy access to a broad base of information. Second, through weekly project activities, students learn how the Internet can help them be contributing members of society in the age of the "global village." These activities tap into the Internet's strengths of allowing interactive informative exchanges. Finally, through cyber-space field trips students learn how the Internet can help them explore the wonders of the universe in exciting ways that could barely have been imagined only a few years ago. These activities tap into the richness of the information base available on the World Wide Web.

The Internet As A Daily Electronic Newspaper

We propose that the Internet can be effectively used through daily exercises that approach the Internet less like an electronic reference book and more as an electronic newspaper. These exercises are scheduled as daily activities for the same reasons that newspapers are read daily--the focus is on information that is constantly changing, such as current events and weather reports. In addition to exploiting the Internet's strength of provider of up-to-date information, these exercises should utilize the Internet's strengths for easy access to promote integration of the curriculum. to

Internet-Supported Educational Projects

Through the Internet, you can access tremendous resources that have been specifically designed (and are maintained) for classroom science (and other) instruction using the Internet. That is, the projects are designed to teach about a traditional content area and about using the Internet and

telecommunications. The Project Involvement activities focus on using the Internet to interact with students in other settings on relatively large scale projects. Through these resources, students can conduct research and compare their findings with the findings of others (both students from distant classrooms and in some case with real scientists)--a central component of real-world science that was once too impractical to incorporate into classroom activities. Many of these resources lend themselves nicely to a schedule of (about) once-per-week lessons.

Cyber-Space Field Trips

Our third recommendation for using the Internet in the classroom capitalizes on both the quantitative and qualitative richness of the World Wide Web information base in what we call a Cyber Field Trip. These "trips" can be to a geological site such as a volcano, to the "living laboratory of evolution," the Galapagos Islands, a field trip through geologic time via a natural history museum, or even to the Hubble Telescope for pictures from the fringes of the universe.

Never before in the history of civilization have educators had so many places to go and so many project opportunities available to them. In this time of budget cuts for supplies and field trips, the computer is a tool that can be utilized to fill that void. It is up to us to use the Internet to its greatest potential. The Internet's greatest potential is not as an expensive encyclopedia, but as a resource that will allow teachers to use and manipulate the world's knowledge is such a way that our students can explore our planet without having to leave the classroom.

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A Business Computing Course Via Internet

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Abstract: This paper describes a four-month credit course in business computing that has been offered since 1995. The content of the course was Microsoft Windows, Word, Excel, Access and computer concepts. There were no class meetings, and a web page contained the course outline, learning activities and assignments. Students and the instructor communicated by phone, Microsoft NetMeeting, and email. The textbook was tutorial-based to facilitate home study. Assignments were submitted by email, marked, and feedback was returned to the student, also by email. About 40% of registered students completed the course, and those finishing were very satisfied with the results. For this business computing course, it was felt that at least one-third of all students can benefit from this alternative method of delivery.

Introduction

This paper describes a 15-week college credit course in the area of business computing that was delivered via the World Wide Web. This means that students took the course at home or at work as opposed to the traditional means of delivery in a computer lab at the institution, and with an instructor present. The course was offered successfully four times since January of 1995 at Grant MacEwan Community College in Edmonton, Alberta, Canada.

Background

MM131.3 Business Computing was offered as a service course since the mid 1980s to business majors and as a core course to computer majors. It was a first year course in computer concepts, a microcomputer operating system, word processing, spreadsheet and database. With the advent of the World Wide Web in the early 1990s, it was felt that the course could be delivered via the Web to students without requiring them to come to the institution for face-to-face instruction. This gave them a choice in the matter, and the possibility of alternative delivery right into their homes. A pilot project was initiated, and the course was made available to any student in the college requiring a business computing course.

Assumptions

In the traditional delivery mode, this course was offered to students in a 30-workstation microcomputer lab with an instructor giving demonstrations with an overhead projector and a projection panel, and tutorial assistance was available to students as required while doing assignments. The course was taught over a 15-week period, with 3 hours of class meetings per week. The goal of the course was to get learners comfortable with word processing, spreadsheet and database applications in order to support their other class work and/or their paid work. Since students came in with a variety of computing backgrounds, it was felt that, given the appropriate environment, that many students could complete the course on their own with access to the instructor for questions via email or telephone when necessary.

Course Content

The MM 131.3 course consisted of a business problem solving approach to the main components of the Microsoft Office Professional 97 suite. In Windows 95, the topics included operating system interface and operation, and file management. The Word portion dealt with creating, formatting and editing documents, large document techniques, and desktop publishing. The Excel part covered creating, formatting and editing spreadsheets as well as functions, formulas and charts. The Access module contained work on database concepts, tables, queries, forms and reports. Computer concepts included general structure, function and applications of computers plus peripherals, communications and networking. There was also a section on integration whose focus was data sharing between the Word, Excel, Access and Internet applications. The textbook took a tutorial approach to the material, and each chapter began with a description of a business whose specific problem was solved using the features under discussion. This allowed the student to work on the material with most of the "hows" and "whys" close at hand.

Delivery

Students, upon enrolment in the course, contacted the instructor for details and exchanged email addresses with him. At that time, the students were also given the course URL and the textbook publisher's URL. They then consulted the course web page, downloaded the files required, and proceeded through the learning activities and assignments. Assignments were submitted to the instructor via email file attachment, and they received feedback and a mark via return email. Questions were answered by phone, by email, or by a demonstration/collaboration session in Microsoft NetMeeting. When all assignments were completed, students made an appointment to write the final examination at the college or with a proctor.

The URL of the course was http://www.gmcc.ab.ca/~scott/mm95 (username: mm131gmcc; password: bits96). It contained a course outline, course regulations, instructions on how to obtain the files to accompany the text, learning activities, assignments, and instructor's notes on critical points. It also contained links to the Microsoft home page (http://www.microsoft.com) and to the home page of the textbook publisher, Course Technology (http://www.course.com).

Response of Students

Over the period of time in which the course was offered, it was found that about 40% of students completed the course. Not all students were self-motivated, although both the "open entry/open exit" format and the idea of no set class meeting times were attractive to those signing up. Indeed, one student had an extended trip out of town, and two students had babies during their time in the class. All three were able to complete the course satisfactorily upon their return to full functionality, with no risk to their final grade in the course. Several successful candidates have been admitted to programs requiring this course. Anecdotal written feedback from students indicated they were very satisfied with the results, and felt it prepared them for the next course in sequence. It is quite likely that up to one third of all students could benefit from this mode of learning.

Challenges

There were several challenges to implementing an instructional approach of this nature. Screening students who would benefit from the approach, and can handle the self-study method by keeping on track was difficult. So far, students were simply asked if they consider themselves to be self-motivated, and they enrolled if the quick answer was "yes." Marketing the course has also been a problem, as the course would be of benefit to many others who live more than a few kilometers from the institution. The majority of the students were from the local area, if not also taking other courses at the college, and many were indeed crediting the course to a two-year program leading to a diploma. A last challenge was making the course known and available to disabled persons, who, given access to the appropriate equipment, would benefit greatly from a learning mode such as this.

The Future

This course and others will continue to be offered to all college students. Indeed, it is planned to convert the first year of the Microcomputer Specialist program at Grant MacEwan Community College to Internet delivery format. Other courses at the college have already been converted to this method of instruction, and all with at least modest success. The College is committed to move forward in the area of alternative instructional delivery, and this course is one step in that journey.

The Internet, and other platforms it spawns, will soon become an accepted playing field for many educators. Many students are, and will continue to learn using Internet as a convenient and powerful instructional delivery mode and research tool. This is extremely important as we enter an era in which lifelong learning will be valued as much as traditional schooling. Not since the invention of printing has there been anything that will influence education as much as this resource.

Semantic Highlighting on the WWW: Educational Implications

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Abstract: The main method of locating information on the World Wide Web is to use a search engine. Given a set of terms, a search engine will return a list of documents containing those terms. Often, though, this list of documents is extremely large. Unfortunately, there are currently no tools to assist the information seeker in determining whether these documents contain desired information, or just submitted terms. Two types of search engine errors are possible: false positive errors result from the many connotations which words may convey, and false negative errors result from different wordings that express similar meanings. To solve these difficulties, we focus on meaning rather than terms, developing a technique called Semantic Highlighting. This technique enables experts and instructors to highlight the most pertinent portions of documents in a hierarchical manner, allowing students, colleagues and other users to search more efficiently. It also allows for instructors and experts to assess and communicate directly their assessment of the importance of elements within the documents.

Introduction

Studying the written word is arguably the single most intellectually demanding and time-consuming task of any adult learner. The sustained mental effort of critical thinking, analysis, and interpretation is essential for the learner to develop his/her understanding. Online documents have the great advantage of lower cost and wider availability than paper-based documents. However, in their current forms, online documents appear to be poorer learning tools than their paper-based equivalents. For documents more than a few pages long, users often make a hard copy. This implies that paper documents still offer significant advantages over their onscreen counterparts when it comes to reading significant amounts of non-trivial text. With Semantic Highlighting, we are trying to narrow this gap and enable users to directly manipulate the online documents (in this case the HTML file) without changing the original contents of the document.

The Internet is an important information resource and it will remain so for years to come. Virtually all publicly-accessible data will soon be on it (Metcalfe, 1997). Due to the expansion of the Internet, it will become increasingly more difficult to quickly and effectively locate information.

Many visual information seeking and retrieval methods have been developed to support individuals as they browse, search and mine for data. The search process typically begins with only a broad concept of the details required. Then, as the concept becomes clearer, unwanted data is filtered out and the focus turns to the relevant terms remaining. Finally, the specific details that the search has uncovered are retrieved (Schneiderman, 1997).

On the World Wide Web, this search process usually involves a search engine. Given a set of terms, a search engine will return a list of documents containing those terms. This list is usually ranked according to the total number of hits, or total times all search terms were found, within the document. This system of ranking is often misleading, as it only takes into account the total number of matches without regard for the distribution of those matches among the submitted terms. Also, the list of documents returned is often extremely large. Unfortunately, there are currently no tools available to assist the user in

determining whether retrieved documents contain desired information, or just submitted terms. Often users must browse many of the returned documents to find relevant data. This is obviously a frustrating and time-consuming process. Two types of search engine errors are possible that cause this phenomena: false positive errors result from the many connotations which words may convey, and false negative errors result from different wordings that express similar meanings. Semantic Highlighting has been developed to focus on meaning rather than terms in a search process.

Why Highlight while Reviewing Documents?

Students often sit down with daunting textbooks and highlighting markers, hoping to flag all significant bits of information. Sometimes they end up with entire pages of highlighted text. Used correctly, the highlighting marker can help emphasize and locate important portions of printed text quickly and easily (Sanders, 1996). Thus, highlighting written text is an important skill to develop. This skill is based on the ability to recognize main ideas and supporting details. In addition, a document could be highlighted in order to outline, classify (customize the information), direct attention, guide, and aid navigation. Until now, highlighting of electronic documents has only been used in a syntactic way, to cause the viewer to notice that a phrase is 'clickable' or 'selected' (Marcus 1992 and Preece et. al. 1994).

When re-reading a document, it is useful to be able to skim the familiar material and focus quickly on the new material. To support this task of efficiently re-reading, a learner typically marks, highlights, and annotates--an important part of processing the information. This activity also generates visual impressions of individual pages, which can be useful in finding particular parts of a document again. Highlighting makes learning quicker and easier, as one can re-read the highlighted parts over and over to learn them. This accords with O'Shea's (1997) call for educational interfaces to "develop effective memory prostheses that support the learner in recalling the fine detail of an increasing volume of electronic interaction". Paper documents always allow the reader to underline, but the support for underlining is often poor or even absent in online documents. Semantic Highlighting offers a solution to this problem.

What is Semantic Highlighting?

The information now available on the Internet pertaining to a particular topic varies greatly in both quantity and quality. The World Wide Web has enabled users to electronically publish information making it easily accessible to millions of people. However, the ability of those people to find relevant material has decreased dramatically as the quantity of information on the Internet grows.

One emerging trend is to enable the user to describe their own material with metadata, "information about data" (Iannella and Waugh, 1997). Warwick (1997) writes that "an element of metadata describes an information resource, or helps provide access to an information resource. Metadata can be use to describe an Internet resource; what it is, what it is about, where it is, and so on." There are three major aspects for the deployment of metadata: description of resources, production of the metadata, and use of the metadata. The key issue is that metadata helps to preserve the contents of the original document. Semantic Highlighting is simply adding a new layer of information (metadata) above the original content layer. The highlighting layer can be removed or modified at any time without interference with the original content layer.

Semantic Highlighting is similar to traditional highlighting, but it is performed on electronic documents, initially those in the Hypertext Markup Language format (HTML) (Hussam et. Al. 1998). Semantic Highlighting allows its users to highlight relevant electronic information directly within a web browser window either manually or automatically through the use of key words. The Semantic Highlighting tools also allow users to view documents highlighted by others, including experts in the field of study addressed by the document. Semantic Highlighting Tools offer users the ability perform the following functions on electronic documents:

- Highlight manually
- Highlight automatically using search strings
- Compare/contrast documents highlighted by different users
- Generate outlines from highlighted content
- Customize highlight colors and categories
- View an entire document's highlighted representation through hierarchical icons

- Save highlighted documents locally or publish them to a server

How Semantic Highlighting Reduces Internet Data Retrieval Time

Semantic Highlighting can reduce the time required to retrieve information on the Internet in two ways. First, Semantic Highlighting can enhance the existing search engine experience, making it quicker and easier for users to find information (Semantic Highlighting Automatic Mode). Secondly, a Semantic Highlighting search domain can be established for documents previously highlighted by experts, allowing users to access pre-classified information (Semantic Highlighting Experts Mode).

In either case, documents retrieved from a search engine can be displayed using the Semantic Highlighting graphical format. This format will allow users to quickly decide which documents contain their desired content. The format will also allow users to rapidly locate that content and immediately see the relations between search terms.

The first hierarchical level of Semantic Highlighting's graphical format adds a pie chart icon and term color-code to standard search engine outputs. By stating the total number of hits each document contains next to a pie chart representing the relative distribution of those hits, users can quickly determine which documents contain the most relevant information. The color-code for each search term is shown in a separate frame below the search engine's output.

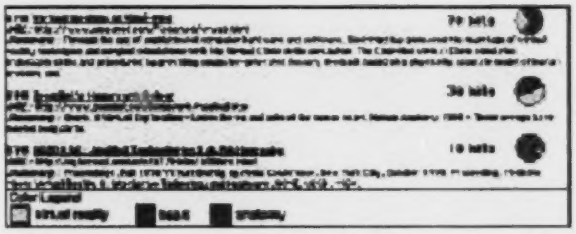

Fig. 1: Semantic Highlighting enhanced search engine output

The second level of Semantic Highlighting can be invoked when a user has determined that a particular document contains the desired information. By 'clicking' on the pie chart icon, the Semantic Highlighting tools will parse the document into standard sixty-line pages. Then, the tools will determine which pages have the highest density of relevant content. These pages will be displayed as thumbnail versions of the full-sized color-coded highlighted pages. The remaining pages will be hierarchically grouped under 'clickable' pie chart icons similar to those in the previous level. This representation will allow users to quickly find the greatest density of relevant content within a document.

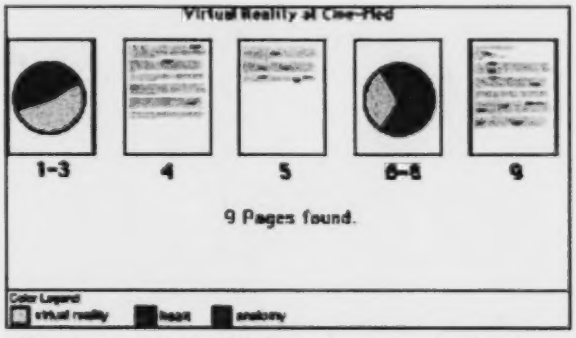

Fig. 2: Semantic Highlighting document visualization

Finally, by 'clicking' on the thumbnail pages, users can retrieve a full-sized version with the color-coded highlights intact.

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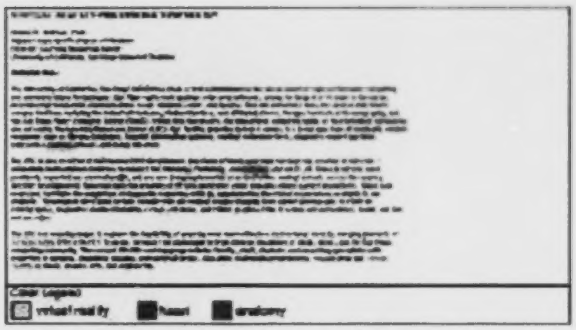

Fig. 3: Semantic Highlighting highlighted document

Semantic Highlighting and Education

In an educational setting, HTML documents that have been analyzed and highlighted by a faculty member or expert may be presented to students. The faculty member or expert will classify the information into pre-defined categories such as main point, major ideas, important terms, etc., based on their knowledge, research, and experience. Students can view their own teachers' highlights and those of other experts. They can also compare and contrast any two sets of highlights. This ability will greatly assist students in understanding the level of importance faculty members and experts place on various pieces of information available on the Web. Using the customization tools, faculty can also generate unique highlighting categories to guide students more efficiently through online class material. This extra guidance will reduce the amount of irrelevant data students retrieve from the Web, provide a condensed set of review material, and help students retain important information (see figures 4 and 5).

Students can also perform their own highlighting on HTML documents. They can then compare their highlights to those of faculty members, experts, or classmates. This comparison will provide students the tools needed to extract important details from a document based on categories defined by the instructor. Also, students can generate outlines from the highlighted material.

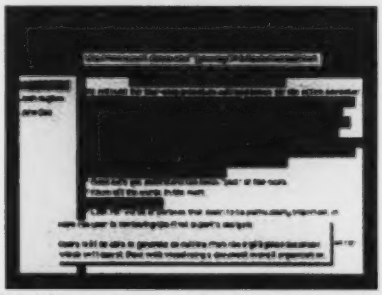

Figure 4: A document is highlighted by an expert. Red represents the main point and green represents examples.

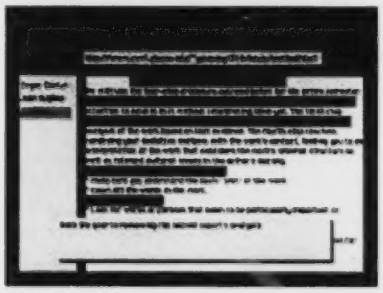

Figure 5: The same document is highlighted by another expert. Red represents the main point and green represents examples.

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Examples of Using Semantic Highlighting as a Teaching Tool

The following are descriptions of the benefits of Semantic Highlighting in the classroom, provided by faculty members of the University of Missouri-Columbia. Currently these assumptions are based on a conceptual model of Semantic Highlighting. However, by Fall 1998, the faculty will be able to experience these perceived benefits firsthand, as they will be able to use Semantic Highlighting Tools. Several surveys will be conducted to test the validity of Semantic Highlighting use in the classroom, with the results to be published in a future paper. Testing will be conducted simultaneously in Europe and the United States to evaluate Semantic Highlighting in different educational settings.

Dr. Gail S. Ludwig
Department of Geography

A geography student came huffing and puffing to my mapping science class last semester carrying a ten pound notebook filled with pages of web-based documents. I was both amazed and flabbergasted by the thought of all the time, effort and resources (especially paper!) this student expended to capture the information I had linked to my web-based class syllabus. My query as to why the student printed ALL the linked information in the syllabus was met with the standard answer, "Because you might test us on this material".

To give better focus and direction to my students, I downloaded several of the online documents and imported them into a word processing program. Using the bold and italic options, I went through several of the documents identifying the important concepts and ideas contained in the paper. At the end of the class, I felt like the students had a better grasp of identifying key concepts within the paper. The students' next questions were predictable. "Why," the students asked, "couldn't I do this type of highlighting online?" It was a good question and stimulated a great deal of discussion. Why couldn't I highlight the important sections of the web-based documents? Why couldn't I prioritize document content for my students?

The development of Semantic Highlighting as an educational tool to assist teachers, students and general web users to manage the vast amount of information on the Web is a major breakthrough. Like general highlighting done manually in textbooks, it can help identify the key concepts and ideas the instructor feels are important. These highlighted sections will be visible to his/her students logging onto the site. In addition, the students will have the ability to do their own highlighting and compare it with what other students in their class feel is important, or even what other experts in the field identify as important. It will allow a type of collaborative learning to take place on the Web. Although the interaction between students and faculty will not be face-to-face or in real-time, it will allow individuals to work together, examining and evaluating online documents.

Semantic Highlighting is an exciting development that can help educators harness the vast amount of resources on the Web. It can help avoid the information overload that often is experienced when thousands of web sites have information on a specific topic. It is a new tool that educators can add to their technology toolbox to assist them in organizing, prioritizing and understanding the resources available via the World Wide Web.

Dr. Mike Prewitt,
Health Related Sciences
Respiratory Therapy

Keeping up with the medical literature is a strenuous proposition. The stacks of unread journals that collect on desks and in filing cabinets continue to grow larger as our time to read them shrinks. Yet we are pressed to keep current; our patients expect informed practitioners. Students enrolled in health professions programs must, as part of their training, learn to evaluate the strengths and uncover flaws in journal articles. They also must come up with an independent assessment of whether the author's message rings true, and if, in the final analysis, the results are valid. Their task is further complicated by the increasing number of journal articles that contain claims which are tainted by dubious premises, invalid designs, unreliable data, violated assumptions, bias, erroneous methods or

faulty reasoning. The development of Semantic Highlighting, as a tool to assist students, faculty and practitioners in health professions education, would be extremely beneficial in preparing students to evaluate research articles using a practical, critical and efficient approach. Students could compare their journal critiques to those of faculty and other experts in their field, which would provide an effective way to develop skills and ultimately become more efficient at reading health literature.

The Web is changing the way students learn. Computers have become indispensable tools for managing the rapidly growing body of medical information. Semantic Highlighting will become a useful tool in retrieving information in a more efficient and timely manner.

Examples and Future Work

A working example of Semantic Highlighting may be found at: http://pumbaa.atc.missouri.edu/sh.html.

Future work will continue to expand the scope of Semantic Highlighting. Some of the topics currently being considered are:

- Collaborative Semantic Highlighting: This technique will help promote new collaborative learning environments, allowing users to interact in real-time using Semantic Highlighting and chat. Also, these sessions will be more beneficial if a leader or expert is available to facilitate the session.
- Semantic Highlighting Text to Speech: This will allow highlighted text, in outline form, to be read aloud to the user.

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Problem-based Learning in an On-line Course: A Case Study

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Abstract: In this paper we present a description and preliminary findings from an on-going case study involving the use of problem-based learning as a mode of instruction in part of an on-line biotechnology course. Three linked problem-based learning activities were used as the primary instructional vehicles in a module about genetic diseases. The first trial of the problem-based learning module was conducted during Summer Semester 1998. Comparison of pre- and post-test results indicated significant acquisition of fact-based knowledge, while the quality of the written reports was indicative of higher-order processing of the information.

Problem-based learning involves the use of a "real world" problem as a context for learning. It is a student-centered approach to learning with objectives that include: development of critical thinking skills, development of problem-solving abilities, acquisition of knowledge and acquisition of skills that support life-long learning. Problem-based learning is usually conducted in a face-to-face setting and little is known about its use in the virtual environment.

The Course

We are testing a problem-based learning approach in an on-line course entitled "Biotechnology in Agriculture, Food and Human Health" offered by Iowa State University. This is a two-credit survey course that covers technology and applications of biotechnology as well as ethical, legal and social issues associated with its use. The course was developed through a program called Project BIO (*http://project.bio.iastate.edu*). The course consists of on-line lectures that are modeled after lectures in a face-to-face classroom, experiential learning assignments and reading assignments in a required textbook and from various on-line resources. In the on-line lectures, students hear the instructor using RealAudio™ technology and view visual aids delivered as a series of Web-based slides. About 50% of the grade in the course is based on the experiential learning activities and the other 50% is from on-line exams based on content in the on-line lectures and reading material.

The Problem-based Learning Activity

This activity is being used as a learning vehicle in a unit or module about genetic diseases. We have previously used a scaled down version of the activity as an element of the module. Students learn about genetic diseases through three linked problem-based learning activities (see below). Students work on the activities in learning teams composed of 2 or 3 students. The learning teams are established earlier in the course through an assignment called "Learning Teams". In this preliminary assignment students are asked to decide on a name for their learning team, assign responsibilities to team members and test technologies (e.g. e-mail, chat, discussion forum) that could be used to conduct group meetings (synchronously or asynchronously).

The students are given a scenario about Robert, a 29-year-old commuter airline pilot who's mother died of Huntington Disease, an inherited neurological disorder. Individuals who carry the genetic defect begin to show symptoms of the disease in their early 30s and eventually die after a prolonged (10-15 years) and debilitating illness. Robert has a 50% chance of inheriting the disorder. There is a presymptomatic genetic test that Robert could take to determine whether he is carrying the genetic defect and thus whether he will eventually develop

the symptoms of the disease. In the activity, the students are asked to assume the role of Robert and make a rational decision about being tested for the genetic defect.

In *Assignment 1, Defining the Problem*, the learning teams are asked to hold one or more group meetings to brainstorm about the issues involved in Robert's decision and make a list of information they need to gather in order to make a rational decision about being tested. Each learning team is then required to post a list of issues and facts that they need to gather on the class discussion forum. Students are able to view the ideas developed by the other learning teams as well as comments and suggestions from the instructor.

In *Assignment 2, Gathering Information*, the learning teams are asked to gather information about Huntington Disease, other genetic diseases and testing for genetic diseases. The ideas developed in Assignment 1 serve as a guide for gathering information. The assignment includes a list of resources that students may want to use in gathering the information. The list includes links to on-line lectures and experiential learning activities that were previously used for instruction in this module. Students are then asked to submit a report summarizing the information gathered during the assignment.

In *Assignment 3, Solving the Problem*, students are asked to make a rational decision for Robert about being tested for Huntington Disease and to justify their decision. As part of the decision making process, the learning groups are asked to identify individuals who have a stake in Robert's decision, brainstorm about possible solutions and discuss the effect of each solution on the stakeholders.

Preliminary Results and Conclusions

A first trial of this problem-based learning module was conducted during Summer Semester 1998 with nine students. Students had 2.5 weeks, out of the 8 week course, to complete the module. Students were divided into three person learning teams.

Knowledge gained during the module was assessed by tests administered at the beginning and end of the module. The pre- and post-test questions were taken randomly from the same test bank. The average grade on the pre-test was a D (64%) while that on the post-test was a B (83%). This indicates that the factual knowledge was significantly increased as a result of completing the module.

We also compared student performance on the post-test with the performance of a group of 22 students who took the course during Spring Semester 1998. The Genetic Diseases module was taught using an instructor - centered approach during the earlier semester. Questions for both groups were taken from the same test bank. The average grade on the test for the instructor-centered group was 84% (n=22 students) compared with 83% (n=9 students) for the problem-based learning group. This suggests that teaching the module in a problem-based mode does not compromise the acquisition of factual knowledge.

The quality of the written reports was high. Average grades for assignments 1-3 were 86%, 95% and 88%, respectively. This indicates that significant higher order processing of the fact-based information was occurring.

Student attitudes toward the problem-based learning module were mixed. Student evaluations indicated that they liked the independent research, exploring the World Wide Web, learning about Huntington Disease and communicating with other students about the problem. They expressed concerns about team learning in the virtual environment especially its impact on the asynchronous nature of the course, the amount of time required to complete the module and the focus on a single genetic disease.

Acknowledgements

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Authoring Educational Courseware Using OXYGEN

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Abstract
Engaging learners on the web is more than sending web pages to the user. However, for many course delivery software, the smallest atomic unit of delivery is a web page. How content experts can create engaging web pages has largely been ignored or taken for granted. This paper reports an authoring model for creating pedagogically sound courseware components running on the web server. The design is driven by

- the recognition of the team nature of multimedia production efforts,
- the requirement of a scalable approach with an emphasis on the educational quality we endeavor to ensure, and
- the need to reduce the requirement in the computing skills of the content author.

The components reported here represent a wide scope of learning paradigm and are based on the author's Object Extensible Analysis and Generation of Education Content (OXYGEN) engine as part of an open, component-based layered course delivery architecture.

Introduction

From the earliest days of computing, experts have predicted that information technology holds the potential to make major transformations in how people learn [NSF 1995]. The advent of Internet, especially the proliferation of the Web, has led to new ways of doing things. Early attempts to use the web for education exposed many problems. Many researchers have argued that using the new media and technologies in traditional ways is not the answer to "the digital transformation of curriculum" in order to meet the current challenges. One of these challenges arises from the trend of mass education for the Higher Education [Ip 1997]. After years of research, educators are beginning to create a model of learning radically different from the dominant model of the last century. Effective learning is not a passive activity; it is not something just "delivered" to the student, as is assumed in the traditional lecture mode. Learning requires that students think, work with ideas and be actively engaged in their subject materials and the materials' processes [NSF 1995]. There are serious pedagogical issues to be resolved before we can clearly understand what is appropriate and effective for curriculum design in this digital era [Twigg 1996]. Technologically, there are significant issues too. [Roschelle and Kaput 1997] identified that the monolithic approach to educational software has a 'consistent pattern of failure' in providing a cost-effective and scalable solution. [Riesbeck et.el 1995] reported the current problems of tools for authoring education content as follows:

1. Authoring tools are generic programming environments such that an author has to be expert in programming, education, and subject content, all the same time.
2. These tools support very few forms of student input.
3. They are closed systems. Each has its own representational format for subject and pedagogical knowledge and its own set of interface elements.
4. They are rarely matched to student and community needs because development is a one-way process.
5. They are difficult, if not impossible, for a classroom teacher to adapt to the particular needs of a given set of students.
6. They neither take into account nor integrate well into the curriculum and the social structure of the classroom.

The current breed of web-based course delivery software offers little relief. Most of these software provide student management, simple organization and/or navigation of web pages and some form of conferencing. They are electronic books with multiple-choice quizzes packaged with some conference capability. How content experts can create engaging web pages has largely been ignored or assumed. [Ip et al., 1997] discussed the need and design of a technical framework which

1. recognizes the specialised roles of different members in a courseware development team,
2. provides economies of scale and scope, and
3. embraces continuous courseware improvement as a mechanism to extend the useful life of the courseware.

Component-based software architectures, such as Virtual Apparatus (VA) Framework [Ip & Canale 1996] to build engaging interactivity within an educational web pages, are likely to provide a medium to long-term solution to the current problem. However, building every educational web page from scratch, even when most of the education components are re-used, is still a significant effort. To meet the mass education trend and the need to continuously improve the courseware, OXYGEN (Object eXtensible analYsis and Generation of Education coNtent) is created. It provides a mechanism for insulating the content author from the technical details of a highly interactive web page and a database backend for storing the educational content. The ability to extend the features of the templates by server side objects in the OXYGEN engine turns out to be more significant than we originally intended. As we continue to develop OXYGEN, we find that we can build a new pedagogical type of interactive components which cannot be done by components on the client side. This compliments nicely with our efforts basing on the VA framework. This paper discusses the design of OXYGEN and illustrates how OXYGEN is being used in The University of Melbourne.

Brief Outline of the Digital Delivery Architecture where OXYGEN sits

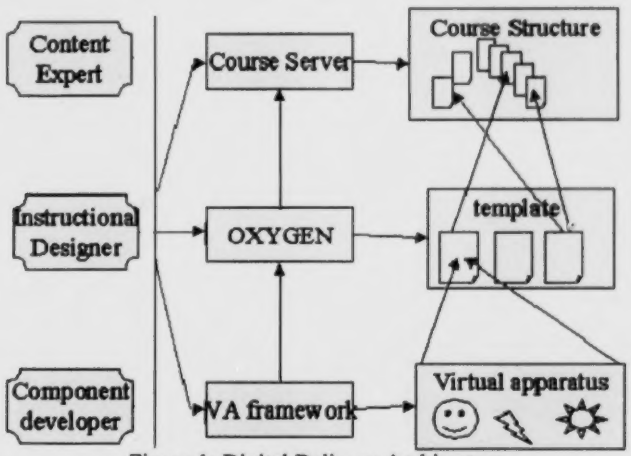

Figure 1: Digital Delivery Architecture

In our approach, content expert, instructional designer and component developer work collaboratively. Component developers represent the lowest tier of development, They are highly skilled technical people creating interactive components (client side components using the VA framework or server side component as OXYGEN templates) for educators' consumption. On the top tier are academics whose expertise lies in content and instruction. They may not have the skill and/or time to work with the technical details of creating the interactive components. Having articulated this dichotomy, we acknowledge the existence of other team members whose role may lie between these two ends and/or people whose interest span the whole continuum.

Typically and being overly simplified, we start by using "scenario capturing" techniques. The content expert articulates how a course will be delivered. Instructional designer converts these scenarios into "use cases", applies his domain expertise in evaluating the pedagogical soundness of the "use cases" and creates templates by recognizing common delivery patterns. Those "use cases" which are not covered by common delivery patterns will be created as standard web pages. The component developers build the web pages and the templates by re-using components, create new component and/or write more HTML codes. These components effectively encapsulate the pedagogical principles of the content expert and instruction designer.

The digital learning architecture reflects our approach. This architecture, of which OXYGEN can be the middle

and/or bottom layer, is the subject of on-going study but beyond the scope of this paper. Briefly, the architecture is three-tiered, each tier being populated with inter-operable components and each tier can be replaced by an engine serving similar functions. The lowest tier of this architecture supporting the higher tiers is the component layer. Our framework for the lowest tier is the VA framework which is essentially a component-based development framework for providing interactivity at the client-side of the delivery [Ip & Canale, 1996; Ip et.el. 1997; Ip & Fritze, 1998]. Our VA components can be built using the common web technologies and are inter-operable, cross-platform and cross-browser. In some situations, these components can be built as OXYGEN templates with additional computational processing on the server side.

In this architecture, prototype web pages are built with or without components. These are converted into templates for the server side OXYGEN engine. The content author interacts with the OXYGEN authoring environment to provide contents and hence built content pages. Content author can also arrange the delivery order of the content pages using the course server.

Virtual Apparatus Framework is for re-use of other people's effort in building interactive functionalities into our own courseware web pages. OXYGEN is about re-using academic's own effort of creating a pedagogically sound content model and additional components requiring the support of the web server. Typically, the content expert designs the content model, commissions the components to be built and then connects with other components to create a prototype page. With the prototype page as a template, the content model can be used in different parts of the course, a different course or to deliver alternate content for mass customization to meet a wide range of student expectations and ability. This systemic approach towards re-use improves our courseware development effectiveness significantly.

Object Extensible Analysis and Generation of Education Content (OXYGEN)

Architecture Description

Although the term "template" is used in this discussion, it must be stressed that the connotation of a boilerplate with no flexibility should not be associated with the word "template" in this context. First of all, the template is created by the academic, with the collaboration of other parties, to address a specific pedagogical need. Secondly, there can be as many templates as needed in a courseware. Thirdly, the OXYGEN templates can allow variations. This approach ensures easy creation of content and/or alternate content delivery.

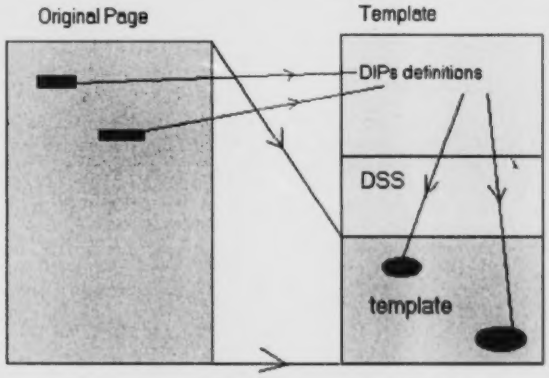

Figure 2: Converting a webpage into an OXYGEN template

In the OXYGEN engine, the fixed (e.g., common elements of the template) and changeable data (e.g., course content) are identified in a Web page. The changeable data components are replaced by Data Insertion Points (DIP) as in conventional template design.

DIPs act primarily as placeholders in the template for content to be inserted. These DIPs are given names so that

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they can be individually referred to in different parts of the template. However, in the OXYGEN engine each DIP is supported by a Data Support Structure (DSS) on the server-side.

Among other things, the Data Support Structure consists of three views: the authoring view, what the intended user sees, and data storage.

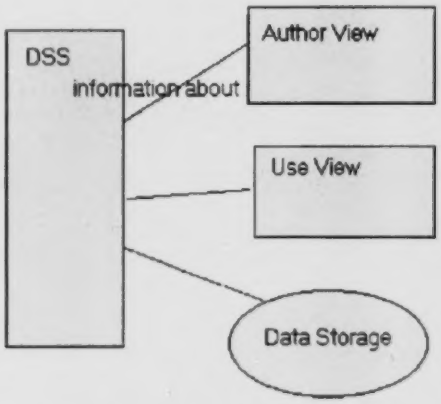

Figure 3: Multiple views of Data in the OXYGEN template

The authoring view stores the visual representation for the content expert. It is typically a block of HTML code of part of a form. It contains instruction to the content expert about what is expected for the DIP in question. Typically, the original data from the prototype page is kept and is used as the default in the authoring view. This provides a good example for the author.

The authoring view is tightly coupled with a data storage instruction. For a simple substitution type of DIP, the data storage can be very simple. However, for a DIP which represents a set of questions, each question is stored as a separate record in the database. In another situation, the data may be a URL and the real data for delivery will be fetched when the template is being used.

The user view takes the data from the data storage and renders it according to the original formatting instruction.

The current implementation of OXYGEN is based on a Windows NT server running IIS 3.0. Because there are server side components, the implementation may not port over to other platforms easily. However, the cross-platform requirement may not be an issue for authoring and delivery of web courses as they are a one time capital investment.

OXYGEN in Action

At the time of this writing, the authoring interface is a form-based Web interface consisting of "author views" of some of the DIPs found in an OXYGEN template. Some of DIP may not have an "author view". Other forms of authoring interface can be created by virtue of OXYGEN's object-oriented nature.

As the content expert enters data into the authoring form, the data is stored at a database. Special mechanism is available to enter a "rule" of finding the data instead of the actual data. This allows alternate content delivery as discussion in a later section.

When it comes to the time a page based on one of the templates is to be delivered, the web server will either fill in the DIPs with specific content just before delivery. The content can be fetched either directly from the database or found using the rule as specified.

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Current uses OXYGEN

NALSAS

OXYGEN is being used as the main delivery mechanism for NALSAS project. NALSAS (National Asian Languages and Studies in Australian Schools Taskforce) project is a multimedia course to teach Mandarin to teachers via the Web. The NALSAS course is divided into four topic areas. Each topic area is further divided into three modules. Each module has two sets of instruction content, a magazine and a set of assessment activities. One typical use of the power of OXYGEN is in one of the assessment for all the instruction content (24 in total). The content expert has determined that for retention of the new vocabulary learnt in the set, a flash card exercise will be used. Since the new vocabulary being learnt is stored in the database for other purposes, instead of specifying the vocabulary for the 24 exercises, a rule is used in the flashcard template.

The navigation in this project is also interesting. By retrieving the last location of a student, OXYGEN customizes the navigation to highlight the next topic the student should take.

LEO

Learning Evaluation Online (LEO) [Ip & Kennedy, 1998] is an on-line service available via the Web for developing, constructing, delivering survey on-line. Our evaluation of LEO has been very positive.

The template has five parts. In the first four parts the survey author inserts data into an introduction, the objectives of survey (optional), the respondent's bibliography (optional), and specifies the survey questions. The final part provides a unique ID to identify each respondent.

From the implementation point of view,

- The introduction. The survey designer provides a brief description and purpose of the survey. This is a simple substitution type of DIP. The introduction entered by the survey author is stored directly in the database. When the survey is delivered, the introduction DIP is the data in the database.
- The survey objectives. A hypertext link to the survey objectives. This is a typical example of "referencing" data. The actual data inserted at the DIP is another URL which access the real data. In this implementation, it is another LEO template.
- The bibliography. By selecting some check boxes, the survey author generates a set of questions (e.g., name, course number, etc.) to be completed by the survey respondents. This is a situation where the authoring view is very different from the use view. Instead of asking the survey author to key in some preset items, a simple selection makes life much easier.
- The survey questions. There are several question templates available— e.g. a Likert-style question, true-false type question, and open-ended question. The number and content of survey questions are determined by the author during survey design time. Hence, in the LEO template, the survey question DIP represents a set (which may have more than one item) and is further complicated by the available question types.
- The Unique ID. This is generated when a respondent submits a survey. This is a typical "late binding" DIP.

The implementation of LEO using OXYGEN is interesting in the sense that it requires most of OXYGEN's capability and illustrates the flexible nature of the OXYGEN engine.

LEO is being used in several projects for evaluation, such as the Interactive Graphing Tool project [Kennedy & Fritze, 1998], CyberShakespear, NALSAS, Survey of Student Expectations About Carrying Out Assignments.

ANN

Annotation (ANN) allows web page owners to set up a facility for readers to annotate web pages. All annotation will be stored on our database and become accessible to other readers. ANN can be treated as a simple conferencing tool with a single thread and focuses on the topic in discussion. It is modeled as a Post-it sticker on the web page.

TAO

Text Analysis Object (TAO) is a new class of tool to analysis free text responses from learners. The answer consists of concepts and details which are scored separately. Feedback is provided to the student to help him/her to get the concepts and details correct. This is a reflective tool when the learner is encouraged to spend some time to think about a specific question and try to generate the best answer to a question through repeated attempts.

QPLUS

Question Plus (QPlus) allows a teacher to mimic and improve a classroom situation. In a real classroom, when a teacher asks a question as soon as one student attempts the question openly, the rest of the class is deprived of the privilege of attempting a "first-time" answer. QPlus enables the content author to pose a question and students will be able to see other's response only after they have submitted their version of the answer.

Conclusion

Mainstreaming digital education is costly and labour intensive. The work described here is an attempt to contain the cost and re-use the hard work various parties have put into the task. We need a mechanism to shield the technical complexity of the development of highly interactive courseware from the content author. This can enable the content author to concentrate on creating the content and can help to ease the already too heavy workload from the academic. With this, we hope to see more adaptive interactive courseware being produced. The tools (LEO, ANN, TAO and QPLUS) are available for trial and use by accessing this url:
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RACE/ETHNICITY AND THE WORLD WIDE WEB: THE VISION-THE REALITY-THE VISION

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Abstract: The World Wide Web (Web) has the potential to reduce existing educational and economic gaps among racial/ethnic groups in the US. But it also has the potential to exacerbate them. Recent evidence points to a digital divide; racial/ethnic minority groups are underrepresented on the Web compared to their representation in the U.S. population. The digital divide has been attributed to differences in access to computers, suggesting that increasing access will eliminate the divide. Research in progress is examining alternative explanations, specifically, cognitive, affective, and motivational factors that may be contributing to the underrepresentation of racial/ethnic minorities on the Web. Support for these alternative explanations will suggest changes in the technology and how it is introduced will be critical to achieving full participation of all citizens in the information superhighway.

WHO'S ON THE WORLD WIDE WEB?

The Graphic, Visualization and Usability Center (GVU) of the Georgia Institute of Technology has been collecting information about the race/ethnicity of Web users since 1995. Figure 1 is based on the GVU Web Surveys (GVU, 1995-1997).

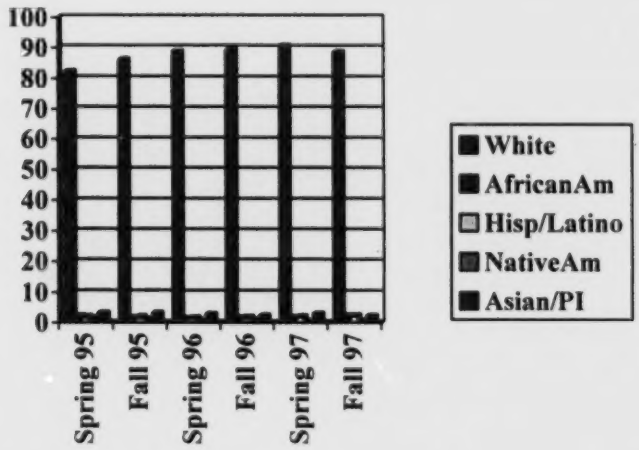

Figure 1: Who's on the World Wide Web? GVU Surveys

As Figure 1 illustrates, racial/ethnic minority groups represent small percentages of web users - a fact that has not changed since the first GVU survey to obtain this information in 1995. More importantly, if demographics projections are considered, the underrepresentation of two groups in particular, African Americans and Latino/Hispanic Americans, will be quite dramatic. These groups will represent almost 40% of the US population but less than 5% of web users by the year 2050!

ACCESS IS NOT ENOUGH

Evidence is beginning to accumulate that equal access to computers and the Internet/Web will not

result in equal usage. Most relevant are findings from the Carnegie Mellon HomeNet project (Keisler et al., 1997), which includes 110 families, 24% of whom are racial/ethnic minorities. Findings indicate that neither income nor education predicted usage, but race/ethnicity did. Others have similarly found that race/ethnicity predicts computer use over and above the effects of income and education (Booser et al., 1991; Hoffman & Novak, 1998; Rand Corporation, 1995).

EXPLANATIONS FOR RACIAL/ETHNIC GROUP DIFFERENCES IN INTERNET?WWW USE

COGNITIVE FACTORS: Race/ethnic group differences in cognitive styles may be contributing to group differences in Internet/Web use. Researchers at the MIT Media Lab, Epistemology and Learning Group, have shed light on how different "ways of knowing" (i.e., epistemological pluralism) may render some groups reluctant to participate in the computer culture (Turkle, 1984; Turkel and Papert, 1990). In our research we are exploring racial/ethnic group differences in computer styles, which we believe are related to cognitive styles (Shade, 1997), and may provide a partial explanation for the underrepresentation of African Americans on the Web.

AFFECTIVE FACTORS: Race/ethnic group differences in affect (i.e., emotions) associated with computers and the computer culture may provide another explanation for group differences in Internet/Web use. Claude Steele's theory of stereotype threat (Steele & Aronson, 1995) suggests that African Americans may disidentify with the computer culture because participation in it threatens self-esteem. Although few studies have examined the affect associated with computers and the computer culture by African Americans, there is reason to believe it is negative. Computers are associated with white males and with social isolation, both of which should contribute to negative affect and disidentification.

MOTIVATIONAL FACTORS: Findings from the Homenet project (Kiesler et al, 1997), discussed earlier, suggest that the motivation behind Internet use for the "average" person is interpersonal communication, not information access. Other research has emphasized the importance of opportunities for personal expression as a driving force behind Internet use (Chandler, 1996). Our research is examining how the introduction of the Internet/Web as a tool for interpersonal communication and self-expression influences Internet use.

INCREASING INTERNET/WEB USE AMONG RACIAL/ETHNIC GROUPS

Recommendations for increasing Internet/Web use among racial/ethnic minority groups will follow from our research. Changes in Internet/Web technology may be needed to make it more compatible with the computer styles of African Americans (cognitive factors). Introducing the Internet/Web in the home may increase the positive affect associated with it. Using the Internet/Web as a tool for interpersonal communication and personal expression may increase motivation to participate in its other dimensions, including its vast informational resources.

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Designing Bots for Advising Systems

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1. Introduction

The WWW keeps on growing. Given that vast amounts of information are part of the WWW, it is hardly surprising that a new generation of tools for information management has been devised to utilize this information. We consider bots or softbots to be the most important of these new tools for information management in the WWW (Schoder & Janetzko, in press). Bots fulfill a number of functions: Bots are second generation internet tools that search for special offers, manage and protect IRCs, signal changes in WWW-sites, inform about new books, translate texts, and carry out simple dialogs to mention just a few areas of application. The philosophy bots differs in two respects from first generation Internet-tools like conventional search engines: First, bots are key in what has been called the information food chain (Etzioni & Weld, 1994). This means that the WWW is a pool of information where information processing devices like meta-search tools, can produce added value by employing the information assembled by more basic information processing devices, e.g., search engines. Thus, the full power of bots is best unleashed as part of more complex information processing systems (like technical systems or organizations). Second, bots are highly specialized tools. The domain where they can be employed is very narrow - however, here they are very powerful. There are good reasons to assume that efficient bots will soon become commercial applications. The goal of this paper is to introduce design-options for chatter-bots that may be used as advising systems. In so doing, we concentrate on chatter-bots, which only process canned text and not natural language. This abstract is organized as follows: First, we will shortly discuss the task of advising, viz., one exemplary task where the chatter-bots outlined in this paper may be utilized. Second, we present three variants of chatter-bots and discuss problems to be addressed when designing each type of bot.

2. Advising

Advising has become a ubiquitous task. When people are presented with complex problems there is the need for advising. The more people are affected by complex problems, the more pressing the need for advice. Companies as well as non-profit organizations spend considerable amounts of money establishing advising services. To achieve a computer-based support for advisory services a number of systems have been set up (e.g., Walz, Bleuer & Maze, 1989). Usually, each domain of advising can be described by a core set of frequently asked questions (FAQs) and a more specific set of expert questions. While the first set can comparatively easily be elicited the second set can't. The idea behind advising chatter-bots is to enable these dialogue systems to answer the core set of FAQs in a domain. What is the advantage of using chatter-bots compared to simply presenting the user simply with a list of FAQs? First, the dialogue may be tailored to the course of the dialogue. Second, a statistics of the questions that are posed may be set up easily. This can be used to identify the foci of information needs. Third, more complex chatter-bots may ask back. This feature is useful to further tailor the course of the dialogue. Finally, using chatter-bots is a dynamic and thus more interesting way of receiving information. This may prove to be useful when advising people who may be easily frightened away by large bodies of text. By definition, advisory chatter-bots, which only cover FAQs, can't answer expert questions. However, by using them expert human advisors (e.g., in a hot-line service) may be freed from a considerable amount of "advising traffic" allowing them to concentrate on expert questions.

3. Design Options

We will now give an outline of three types of advisory chatter-bots along with a discussion of the effort required to implement them and the question of using them. Depending on the initiative taken by the dialogue partners we may distinguish three types of advice giving chatter-bots. For developing all types of bots it is useful to have a pool of questions frequently asked in the domain of advising where the bots are to be used.

Type I User asks - Bot answers

Type II Bot asks - User answers

Type III User/Bot asks - Bot/User answers

I - User asks - Bot answers. This is the most simple chatter-bot. There are several design options for realizing the way the user can pose questions. First, questions the user can ask may simply be listed in a menu. However, this procedure becomes difficult if there is a long list of questions. Second, instead of using a flat list, the questions may also be presented in partitions or in a hierarchy. Third, the questions may also be presented in a context-sensitive fashion so that some question only become available if other questions have been posed already. Chatter-bots of this type may be used as advisory or information systems.

II - Bot asks - User answers. This type of bot seems to be a simple reversal of the first type of bot. However, this is not the case. The second type of bot has to be equipped with an important aspect that was missing in the first one: the capability to initiate and to steer dialogues. These mechanisms may be on a more general (a plan for the whole dialogue) or on a more specific (context-sensitive steering of a dialogue) level. The options for the answers of the user may again be menu-based. In addition, it is desirable to have a field where the user can add short answers or numbers. Chatter-bots of this type may be used to carry out diagnoses, and structured interviews, e.g., job interviews.

Type III User/Bot asks - Bot/User answers. This type of bot is the most sophisticated of the bots introduced here. What has been said about bots of the second type concerning the user options also holds for the third type of bot. In addition, a mechanism for turn taking has to be implemented. Turn taking may be offered (e.g., "Do you have any questions?"), taken (e.g. "May I ask a question?") or time-dependent (i.e., after a certain interval with no dialogue exchange the bot reinitiates the dialogue). Chatter bots of this kind are actually WWW-based expert-systems. They can be used to run complex diagnostic or advisory systems.

3. Discussion

Advising systems have recently received considerable attention (Katz, 1993; Bykat, 1997; Hasebrook & Nathusius, 1997). However, these systems are only as stand-alone systems. Bots may be used to realize WWW-based advisory system that go beyond stand-alone systems with respect to both availability and naturalness of the interaction mode. In addition, systems like this may be used as an efficient front-end for a number of WWW-based applications (e.g., selecting an appropriate product, flight etc.). Although bots introduced in this paper do not process natural language but only canned text, they may be employed in a number of dialogue scenarios. In the full version of this paper we will gave a more technical account of the the types of bots introduced along with an evaluation of these systems.

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SEARCHERS, THE SUBJECTS THEY SEARCH, AND SUFFICIENCY: A STUDY OF A LARGE SAMPLE OF *EXCITE* SEARCHES

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ABSTRACT: In apparently the largest study of actual Web searches, we analyzed transaction logs of a set of 51,453 queries posed by 18,113 users of Excite, a major Internet search service. This study focuses on three areas. First, we examined query construction, providing data on the number of terms in queries, the use of Boolean logic, use of other term modifiers, and the modifications to queries by users. Second, we examined the search terms, including the most commonly used search terms and the rank/frequency distribution of search terms. Finally, in order to get an indication of the performance of the search engine and user satisfaction with current searching techniques, we supplement the quantitative analysis with the results of a survey of Excite users. This indication of performance is a component of sufficiency, a metric that measure how well a search engine satisfies a user's information desire. Implications for Web and information retrieval systems interface design are discussed.

INTRODUCTION

With the phenomenal increase in usage of the World Wide Web (the Web), there has been growing interest in the study of a variety of topics and issues related to use of the Web. However, to date there has been no large-scale, quantitative study of Web searching by users. *How do they search the Web? What do they search for on the Web? Are they satisfied with the results they receive?* These questions are addressed, as far as we can ascertain, for the first time on a large scale in this study.

In this paper, we report results from a major and ongoing study of users' searching behavior on the Web. We examined a set of transaction logs of users' searches and responses to a survey done on Excite (http://www.excite.com), a major Web search engine. The objectives of the study reported here were to analyze (1) the size, logical structure, and modification of queries; (2) the distribution and nature of search terms, (3) to get and indication if users are satisfied with the current system. The study involved real users, as they interacted with Excite for searching, capturing their queries as stated. This was a naturalistic case study, rather than a lab study, with all its strengths and weaknesses. This brings us to the significance of this study, which is:

> *"The success or failure of any interactive system and technology is contingent on the extend to which user issues, the human factors, are addressed right from the beginning to the very end, right from theory, conceptualization, and design process to development, evaluation, and to provision of services.* [Saracevic, 1997a).

Queries and searching are major human issues. The more insight we have on how these are actually done, the higher the probability that that insight may be translated into improved search engines and better IR. It can provide sharper criteria for the development and improvement of Web information retrieval (IR) systems and interfaces, as well as other IR systems. Finally, such an insight can benefit user education and training programs.

RELATED STUDIES

In this paper, we concentrate on users' *queries, search terms, and subjective opinions* as key variables in IR interaction on the Web. While there are many papers that discuss some aspects of Web searching, most of those are descriptive, prescriptive, or commentary. We could not find any studies of Web searching similar to this one, containing data on searches; thus we have nothing to compare. However, there were several studies that included data on searching of existing, mostly commercial IR systems, and we culled data from those to provide for some comparison. Fenichel [1981] did a pioneering study in this area. Hsieh-yee [1993] compared the search term use and search tactics of novices searchers and expert searchers. Bates et. al. [1993] studied search. Spink and Saracevic [1997] analyzed searches done by professional searchers in interaction with users. These studies are hard to compare. Still, each of them had data on the number of search terms used by searchers under study. A picture emerges showing that searches of these various populations contain a range of some 7 to 15 terms. As will be discussed below, this is a considerably higher range than the mean number of terms found in this study.

BACKGROUND ON EXCITE AND DATA

Founded in 1994, Excite, Inc. is a major Internet media company which offers free Web searching and a variety of other online services. "Excite Search," according to the description in its site " the Internet's most comprehensive search tool, lets you search more than 50 million Web pages, 140,000 Web site listings, and thousands of Usenet postings." According to an independent study "during a 28-day period from Sept. 29, 1997 to Oct. 26, 1997, there were a total of 11,793,000 unique visitors to the Excite Network" (press release by Excite Inc., November 17, 1997]. While this includes all the visits, in addition to searches, it is safe to assume that the overwhelming number of Excite visits are searches. This provides a picture of the huge size of the traffic on Excite. We provide only a brief description of Excite search capabilities. More details are available at their Web site. Those search features that pertain to our results are described here:

- The default option for query terms is OR. So, if a user enters a query of two or more terms, the Excite search engine ORs the terms together by default.
- A set of terms enclosed in quotation marks returns pages with the terms as a phrase in exact order. No space between quotation marks and terms.
- Boolean operators AND, AND NOT, OR can be used, but these operators must appear in ALL CAPS and with a space on each side in order to work. Parentheses are also available for nested Boolean logic.
- A relevance feedback option is available via a "*More Like This*" button.

At the SIGIR 97 conference, Excite representatives offered to make available a set of their searches for analysis to anybody who asked. We took their offer and downloaded 51,453 queries (log transactions) from 18,113 users that were available. The queries examined are a random subset of Excite searches on 10 March 1997. Each transaction record contained three fields: *Time of Day, User Identification, and Query Terms*.

The first field was time of day measured in hours, minutes, and seconds from midnight of 9 March 1997. The next field was user identification assigned by the Excite server, and the third field was the actual query. With these three fields, we were able to locate a user's initial query and recreate the chronological series of queries by each user. This allowed us to examine both the particular actions of individual users and compare actions among all users. We examined this data in the specific areas of the query construction and query terms.

SEARCH STATISTICS

The basic statistics related to search terms and queries are given in Table 1. Queries consist of one or more search terms, and possibly includes logical operators and requirements. A term is any unbroken string of characters (i.e., there is no space between characters). The characters in terms included everything – alphabet, numbers, and symbols. Terms were words, abbreviations, numbers, symbols, URLs, and any combination thereof. Logical operators are also counted as search terms when standing alone. The data is raw and messy – users entered terms in all kinds of ways and combinations, majority correct, but also including many with abbreviations, misspellings, errors and the like. We took the data 'as is,' i.e. we did not 'clean' the data in any way – because these queries represent real searches by real users. We took great care in derivation of counts, but because of the messiness of data there still may be errors – we estimate not more than 1%.

We provide three statistics: (1) Non-unique terms: sum of all terms over all queries making also a distinction for capitalization i.e. case sensitive. (2) Unique terms with case sensitive: count of unique terms

where *Topic, TOPIC,* and *topic* are counted as three terms. (3) Unique terms with case non-sensitive: the three capitalization forms of *topic* are counted as one term.

No. of users	No. of queries	Non-unique terms	Mean of terms And Range	Unique terms with case sensitive	Unique terms without case sensitive
18,113	51,473	113,776	2.21 0-10	27,459	21,837

TABLE 1. Numbers of users, queries, and terms

There were on the average 2.8 queries per user, meaning that a number of users went on and refined in some way their query. *On the average, a query contained 2.21 terms*. As mentioned, we could not find any data on Web searches, thus, we can not compare this average to other Web searching.

Table 2 shows the ranking of all queries by number of terms. The column Terms is the number of terms in the query. Percent is the percentage of queries containing that number of terms relative to the total number of queries.

Terms in query	Number of queries	Percent
>= 5	3,808	7.40
4	3790	7.36
3	9,243	17.96
2	16,191	31.46
1	15,857	30.81
0	2,584	5.02

TABLE 2: Number of Terms in Queries.

Web queries are short. *One in about every three queries had one term only, two out of three had one or two terms, and four out of five had one, two or three terms.* Slightly over 7% of the queries were 5 terms or more. Concerning the queries with zero terms (last row). When a user enters a command for relevance feedback *(More Like This)*, Excite counts that as zero terms. Thus the last row represents the potential largest number of queries that used relevance feedback, or a combination of those and queries where user made some mistake that triggered this result. *If we take that all of them are relevance feedback queries then only one in about twenty queries used that feature.* This is a small use of relevance feedback capability. In comparison with professionally-assisted IR searching from the study by Spink & Saracevic [1997], with the same caveat, it was found that some 11% of search terms came from relevance feedback. The relevance feedback is used half as much on the Web. It is surprising that the users use very little this potentially highly useful and certainly highly vaunted feature.

QUERY CONSTRUCTION

As mentioned, Excite can handle Boolean logical operators, AND, OR, and AND NOT. In addition, parentheses ( ) allow for use of nested logic. We examined how many queries explicitly utilized Boolean operators, including nesting, as presented in Table 3. Boolean operators must be upper case. Additionally, to receive the correct result NOT must be used with AND. The column Incorrect displays the number of queries containing a specific Boolean operator that was constructed incorrectly. The last column is the percentage of queries containing Boolean operators that were incorrectly constructed. In a sense the last two columns pertain to failure analysis.

Operator	Number of queries	Percent of all queries	Incorrect	Percent incorrect
AND	4,798	9.32	1262	26.30
OR	132	0.26	46	34.85
AND NOT	120	0.23	79	65.83
( )	273	0.53	88	32.23

TABLE 3.: Use of Boolean Operators in Queries.

Boolean operators were used very sparingly. Only 5,323 queries, *or about one in every 10 queries contained a Boolean operator,* and in those AND was used by far the most. A minuscule percentage of queries used OR or AND NOT. Only 273 of the total number of 5,323 queries with operators used nested logic – i.e. *only one in about eighteen Boolean searches placed some of the terms with operators in parentheses.* Of those queries that used the Boolean operators, 1262 or about 26% of uses were incorrect. *About one in every three queries that used Boolean operators or parentheses was not entered as required by Excite.* The very small use of Boolean operators and the very large percentage of mistakes when they are used shows that the Web searchers are not up to Boolean. Redesign seems to be in order.

CONTENT AND DISTRIBUTION OF TERMS

The 51,474 queries contained 21,862 unique terms that were non-case sensitive. As mentioned, for counting purposes of these unique terms we normalized all terms to be in lower case. We started with creation of a mega-table that contained distribution of all unique terms ranked from highest to lowest frequency of appearance (lowest frequency being one), but this mega-table is way to large to present. The 74 terms that were used 100 or more times in all queries had a frequency of 20,698 appearances as search terms in all queries. They represent 0.34 % of all unique terms, yet they account for 18.2 % of all 113,776 search terms in all queries. If we delete the 11 common terms that do not carry any content by themselves (*and, of, the, in, for, +,on, to, or, &, a*) that altogether had 9,121 occurrences, we are left with 63 subject terms that have a frequency of 11,577 occurrences – that is 0.29% of unique subject terms account for 10.3% of all terms in all queries. Interestingly, the high appearance of '+' represents also a probable mistake – a space between the sign and a required term. On the other end of the distribution we have 9.790 terms that appeared only once. These terms with frequency of one amounted to 44.78% of all unique terms and 8.6% of all terms in all queries. *In other words, about one in every ten subject terms used in all queries comes from a list of 64 terms. Close to a half of unique terms appeared only once.*

In order to ascertain some broad subjects of searching, we classified the 64 top terms into a set of common themes. Admittedly, such a classification is arbitrary and each reader can use his/her own criteria. Still a rough picture emerges as shown in Table 11. The first Percent column refers to percent of the frequency in the category in relation to the total frequency of 11,577 for all 63 terms; the second Percent column refers to percent of the frequency in the category in relation to the total of 113,776 terms in all queries.

Category	Terms selected from 63 terms with frequency of 100 and higher	Frequency for category	Percent of freq. -63 terms	Percent of all terms
Sexual	*sex, nude, gay, xxx,* ***expletive deleted****, naked, adult, porn, anal, erotic, porno*	2862	24.72	2.51
Modifiers	*free, new, big, real, black, young, de, high, page*	1902	16.42	1.67
Place	*state, american, home, world, york, texas, florida, city*	1144	9.88	1.01
Economic	*employment, jobs, company, business, service, stock, estate, car*	968	8.36	0.85
Pictures	*pictures, pics, photos, video*	906	7.82	0.80
Social	*chat, stories, celebrities, games, john*	804	6.94	0.71
Education	*university, college, school, history*	758	6.54	0.67
Gender	*women, girls, men*	648	5.59	0.60
Sports	*ncaa, basketball, wrestling*	477	4.12	0.42
Computing	*software, computer, internet*	437	3.77	0.38
News	*magazine, news, war*	361	3.12	0.32
Art	*music, art*	310	2.68	0.72

TABLE 4. Subject categories for terms appearing more than 100 times

There is no way of going around it: a lot of terms (and thus queries) dealt with some or other sexual topic. *As to the frequency of appearance, about one in every four terms in the list of 63 highest used terms can be classified as sexual in nature, or if extended to all terms in all queries then we estimate that about one in forty terms is sexual.* Of course, if one classifies some more terms in the category *Sexual* the percent will be higher. We perused the rest of the terms and came to the conclusion than no more than some dozen of other terms will unmistakably fall in that category. If we added them all together the frequency of terms in *Sexual* will increase but not that much, and particularly not in relation to thousands of terms in other categories that are widely spread across all frequencies. While category *Sexual* is certainly big, in comparison to all other categories in no way does it dominate searching. We cannot say that if we categorize the frequency of appearance of all the unique terms that category *Sexual* will even remain the highest category. Considering the shear huge size of remaining terms, it probably will not. Interest in other categories is high, categories that deal with places, economics, social activities, education, sports, computing, and arts. In other words Web searching does cover a gamut of human interests.

SUFFICIENCY

Unfortunately, we could not survey the actual users of our quantitative analysis to determine if their searches had retrieved relevant information. Instead, data was gathered through an interactive eighteen (18) question survey developed by the researchers in conjunction with the staff at EXCITE, Inc. The interactive survey was made available through EXCITE's Home Page for 5 days from Friday April 11 to Tuesday April 15,1997. Only those EXCITE users who accessed EXCITE's Home Page (http://www.EXCITE.com) directly could access the survey form (http://www.unt.edu/survey/excite.html). Only a portion of the survey information is presented here. For an in-depth reporting of results see [Spink, Bateman, and Jansen 1997]. From the on-line survey, most users reported retrieving relevant information from EXCITE on their current topic (Table 12).

Retrieval Status	Number	Percentage
Yes	206	72%
No	80	28%

Table 5. Users' retrieval of relevant information from EXCITE on current topic.

Although the search techniques were sufficient for a high percentage of users, the number that replied *no* was surprisingly high. For reasons outlined in [Spink, Bateman, and Jansen 1998], most of the respondents to the survey were repeat users of Excite, and therefore probably the most skilled in using the Excite tools. So, even with the most experienced users, almost 30% are not satisfied with the current search techniques, search performance, or the data contained within the information base. Based on this figure and the problems that users exhibit with search techniques, it further supports the need for redesign.

SUMMARY

The analysis involved 51,473 queries from 18,113 users, having all together 113,776 terms, of which 21,862 were unique terms disregarding capitalization. We are providing the highlights of our findings:

- The users did not have many queries per search. The mean number of queries per user was 2.8.
- Web queries are short. On the average, a query contained 2.35 terms. Less than 8% of the queries were more than five terms. Relevance feedback was not used that much.
- Boolean operators were not frequently used. About one in 15 queries contained a Boolean operator, and in those AND was used by far the most.
- The distribution of the frequency of use of terms in queries was highly skewed. A few terms were used repeatedly and a lot of terms were used only once.
- There is a lot of searching about sex on the Web, but all together it represents only a small proportion of all searches. A great many other subjects are searched, and the diversity of subjects searched is very high.
- Most respondent of the survey reported retrieving relevant information; however, the number reporting not finding relevant information was surprisingly high.

CONCLUSIONS

We investigated a large sample of searches on the Web, represented by logs of queries from Excite, a major Web search provider. We augmented this sample with an on-line survey. We consider this study just as a beginning. We already downloaded a sample of over a million Excite queries for analysis. In a way, we consider this study as a pilot for analysis of a much larger sample.

While Web search engines follow the basic principles of IR, Web search users seem to differ significantly from users of traditional IR systems, such as those represented by users of DIALOG or assumed users of Text Retrieval Conference (TREC). It is still IR, but a very different IR. Web users are certainly not comfortable with Boolean operators and other advanced means of searching. These facts in themselves emphasize the need to approach design of Web IR systems and search engines in a significantly different way than the design of IR systems as practiced to date. For instance:

- The low use if advanced searching techniques would seem to support the continued research into new types of user interfaces, intelligent user interfaces, or the use of software agents to aid users in a much simplified and transparent manner.
- The impact of the large number of unique terms on key term lists, thesauri, association methods, and latent semantic indexing deserves further investigation – the present methods are not attuned to the richness in the spread of terms.
- The area of browsing and relevance feedback also desires further investigation, among others the question of actual low use of these features should be addressed.
- In itself, the work on investigation and classification of a large number of highly diverse queries presents a theoretical and methodological challenge. The impact of producing a more refined classification may be reflected in making browsing easier for users and precision possibly higher – both highly desirable features.

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Software Agents for Analysis of the Interactions in a Distance Learning Environment

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Abstract:

Trends in distance education show a growing emphasis in collaborative learning, stimulating students to interact among themselves and to exchange ideas. A collaborative environment, however, will demand a higher effort from the teacher, who will have to supervise all the discussions among the learners, so that they do not deviate from the intended topic for the lesson. In this way, this paper presents a Multi-Agent architecture able to monitor the communication tools in a distance learning group. This system will dynamically analyze the discussions taking place in these tools (discussion list, chat and newsgroups), showing to the professor information, such as, the participation profiles of the students, topics and subtopics discussed, groups of learners that interact intensively, etc.

We observe, currently, a great skip of quality in the distance education, due to the use of tools with great potentials available through the Internet. From now on, the new technologies are being used, offering a one-way communication between students and teacher.

It has been observed in distance learning an increasing incentive to the collaboration among the students. This is because the educators believe that this exchange of communication among students improves interest in the study, making them get better results. In the distance education the collaboration can be proportionate by the communication tools available through the Internet, such as: discussion list, newsgroup and chat. The teacher should observe and analyze all the communication exchanged by the students, so that he/she can follow the course of each student, and to verify if the group is respecting the topic proposed for study. This information is very important to the teacher, because it allows to evaluate the students and the course, verifying if the learning has been occurring in the expected level.

However, this incentive to collaboration will result in bigger interaction among the students, higher number of exchanged messages, becoming more difficult to the teacher to monitor the messages exchanged by the students. Although the information collected in the messages is very important to the teacher, the current tools do not aid the teacher in this task. The ED literature recognizes the existence of the problem, it admits the importance and necessity of mechanisms that allow the collaboration among students, but does not present effective solutions in such a way [Palme 97]. Thus, we consider to insert in this learning environment a *multi-agent system of collaboration monitors* able to observe all the interactions that are occurring in a distance learning environment, to extract information in these interactions, to perform some analyses and to transmit the results to the teacher.

The considered multi-agent system has four agents. Three agents, which we will call *collecting agents*, are responsible for collecting information from the messages of the Internet communication mechanisms: *Discussion List*, *Newsgroup* and *Chat*. The fourth agent is the teacher agent who, when requested, will show the analysis made by the other agents, as well as the global analysis that will be carried out by itself. Beyond these, there will be a name server agent, necessary due to the framework adopted for the implementation of the system, the Java Agent Template [Frost 98] version 0.3. This agent has the name and address of all the agents belonging to the society. This agent has the task of supplying the address of an unknown agent for the other agents of the society.

The considered multi-agent system has, for each one of the communication mechanisms of Internet (Discussion List, Chat and Newsgroup), an agent which will periodically search the information in that system. For example, it has a agent in charge for the Discussion List. This agent is activated by the system from time to time and will search all the new messages of e-mail that arrived in the List. In the same way, it will have a agent responsible for the newsgroup, as well as an agent responsible for the log archive of chat.

There are essentially three types of associations that can be identified by the agent in the interactions:
1. Student-student: Identify students that interact intensively among themselves.

2. Student-subject: The agent would search information regarding which subjects, each student more argues. This type of analysis allows to identify which topic interest each one of the students.
3. Student-student-subject: In this type of association the agent will identify the subjects that more interest a specific group of students.

When the agent of the teacher sends a request of analysis to the collecting agents, they send in reply a message with the name and address of the archive that has the analysis. The collecting agents are placed in the local directory of the teacher, where the messages of e-mail and newsgroup are stored. The agent of the teacher, however, will be installed in the machine chosen by the teacher. The general architecture of the Multi-agent system can be visualized in [Fig. 1].

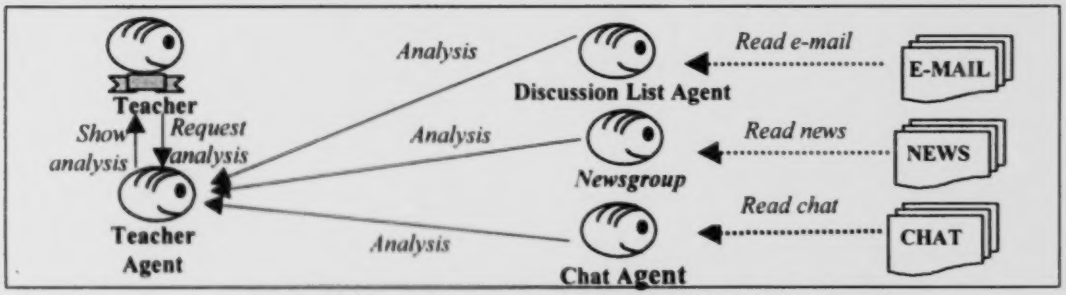

Fig. 1: Multi-agent system architecture for analysis of the interactions in a distance learning environment

While they are reading the new messages, the collecting agents will go to collect some data that will be used for analysis. These information will be stored in a log file that will hold, fundamentally, the following registers: ID (identification for each message of email and newsgroup and chat), From, Reply, Subject, Sub-subject, Date, Hour, Mechanism of Communication *(chat, newsgroup or email).*

The subjects and sub-subjects of the messages will be identified through the *subject* (e-amil or newsgroup) or by keywords in the content of the message. In order to verify the syntactic and morphologic meanings of these words, will be used the Lexis Dictionary (PUCRS, homepage: http://tinos.pucrs.br/links/grupos/lexis/homepage.htm) and a Thesaurus that will be provided by the system. The use of these dictionaries will make possible the agents to identify different words that relate one same subject and pertaining topics to a subject (sub-subjects).

Each agent will have its local database which will store the collected data, as explained above. So, it will make an analysis from the data contained in its database, that will be stored in an archive. In this way, when the teacher requests, it will be sent name and address of the archive that contains the respective analyses. The teacher also can request the analysis of the interactions that had occurred in an intermediary period of time. For the implementation of the multi-agent society we are using **Java Agent Template** framework (JAT) version 0.3 [Frost 98]. JAT supplies a set of classes, written in Java language, that allow the construction of software agents which communicate in a community of agents distributed in the Internet. In JAT, all the messages of the agents use KQML as protocol for communication language. All the functionalities of the agents are being implemented in Java [Cornell & Horstmann 97].

In order to validate this system, we will use it in a virtual distance learning group of the Global Campus of the Pontificia Universitdade Católica do Rio Grande Do Sul (http://www.cglobal.pucrs.br /).

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Interaction and Representation in 3D-Virtual Worlds – from Flatland to Spaceland

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Abstract: The purpose of this paper is to describe interaction and representation in 3D-Virtual Worlds (3D-VWs). First it presents the new media's special characteristics. Then it discusses 3D-VWs on the basis of a set of concepts such as 'places and spaces', 'tours and maps' (Michel de Certeau) as well as 'story and discourse space'. And finally it gives examples of how interaction in 3D-VWs can be described and understood using concepts developed within interpersonal interaction and communication.

"O brave new worlds, That have such people in them!"
E.A. Abbott, *Flatland*, 1884

Introduction – From Flatland to Spaceland

In E.A. Abbott's book, *Flatland*, from 1884 he describes a fictional society that exists in 2 dimensions. All phenomena are described in terms of length and breadth. At one point, the storyteller has a dream about a land of only 1 dimension, the straight line: Lineland. Later he realizes that a third dimension, based on height, exists: Spaceland. He begins to tell the other 'Flatlanders' about the new 'Spaceland' and the newly discovered 3rd dimension. But none of the 'flatlanders' are able to conceive of this dimension since they have never learned to see it.
Our situation today is in many ways similar to the 'flatlanders'. Users and producers of computer and multimedia systems are being trained first by 1-dimensional text-based interfaces (Lineland) and later by 2-dimensional graphic interfaces (Flatland). At this point there are only vague hints of what an expansion into a 3rd dimension – Spaceland – might mean and which possibilities it will open up for representation, aesthetics, and interaction.
The history of 'virtual communities' or 'chat rooms' indicates the same development. It started with text-based virtual communities built up around simple text messaging. This world can be compared to 'Lineland'. Later, 2-dimensional worlds like The Palace arrived with an interface composed of 2-dimensional background pictures in which 2-dimensional, cartoon-like avatars move around – a veritable digital version of Abbott's Flatland. And finally, there are (aside from the 2.5-dimensional worlds like WorldsAway) a long list of 3-dimensional worlds which have arisen lately such as Worlds Chat Space Station, Active Worlds, Black Sun Passport, Oz Virtual, etc. Here the virtual communities are expanding into an Abbott-like Spaceland.

Spaceland ... Turning Surfers into Settlers

3D-Virtual Worlds (3D-VWs) are currently becoming a reality. It happened first in computer games and stand alone multimedia applications, but is increasingly appearing in network-based systems, e.g. the Internet and intranets. 3D-VWs are characterized by being generated from software, drawn as interactive computer graphics in 3 space dimensions (plus a 4th in time) – i.e. they exist only in cyberspace – and by containing computer generated representations of users. In order for users to move through 3D worlds, and so that others can see them, they must be represented as moveable computer graphics, in the form of so called 'avatars'. In other words: this software is inhabited. Bruce Damer writes: "the Internet is about to become a place for people,... cyberspace with a human face ... The best part about these virtual worlds is that when you visit them, you are not alone! Hundreds or even thousands of people are there with you, exploring, communicating, and creating. Every one of these people has chosen a digital body you can see, a kind of virtual persona called an avatar" [Damer 98].
While the Internet has, until now, primarily been a set of sites which could be visited, documents that could be surfed, it is rapidly becoming a space that can be lived in and populated. In these Virtual Worlds it's possible to meet with and have (mediated) social interactions and communication with other users on the network in real time. Via these simulated interactions, a new type of virtual social practice and virtual culture is being created.

The Internet is changing from a pile of documents , a dead library, to a social and communicative space: a web of human relationships – a community. And users are transforming themselves as well from surfers to settlers.
One might call these environments: 'inhabited 3D-Virtual Worlds'. But they have other names as well, such as: 'distributed virtual reality', 'Shared Spaces' [Bradley et al. 96], 'metaverses' [Stephenson 92], virtual cities, 3D Internet, 3D chat, 'the new avatar cyberspace', 'avatar virtual worlds' or 'three-dimensional virtual worlds' [Damer 98]. These 3D worlds are currently enjoying explosive growth. Fully implemented 3D-VWs include: Worlds Chat Space Station, The Palace, Active Worlds/AlphaWorld, Worlds Away, Virtual Places, Onlive! Traveler, Black Sun Passport, Comic Chat, Oz Virtual, and The Mirror/Inhabited TV. Even more 3D-VWs are under construction at the moment. The most important thing in this context, however, is not the futuristic perspective, but that 3D-VWs are already complete technological and social realities – and thereby open to empirical study. It is these 3D-VWs and their virtual interactions and communication that are the primary objects of study for this paper.

'Spaces' and 'Places'

In his book, *The Practice of Everyday Life*, the French sociologist Michel de Certeau deals, among other things, with the spatial practices of everyday life, in other words, the ways in which we use, fill, and live in spaces. For this purpose, he introduces a distinction between 'space' and 'place'.
A place [fr. lieu]: "is the order (of whatever kind) in accord with which elements are distributed in relationships of coexistence" [de Certeau 84]. Here he refers to the fact that elements define each other by their relative placement in relation to each other, in other words, that they occupy different locations at the same time, a location which they define. "A place is thus an instantaneous configuration of positions. It implies an indication of stability" [de Certeau 84]. Every place, then, has its own unique geographic characteristics.
The opposite of a 'place' is a 'space' which de Certeau defines this way: "A *space* exists when one takes into consideration vectors of direction, velocities, and time variables. Thus space is composed of intersections of mobile elements. It is in a sense actuated by the ensemble of movements deployed within it. Space occurs as the effect produced by the operations that orient it, situate it, temporalize it, and make it function in a polyvalent unity of conflictual programs or contractual proximities" [de Certeau 84].
A 'place' is defined as a geometric, timeless entity where things or figures take positions that can be described. It is like a city planner's drawing: ordered, stable and without movement. 'Space', on the other hand, is made up of moving elements. It exists as a result of human practices that provide the place with an orientation and a timeliness. The difference between 'place' and 'space' is then a difference between a geometric, stable space and a social, experienced and dynamic space. de Certeau compares it among other things to the relationship between 'language systems' and 'enunciation': "in relation to place, space is like the word when it is spoken, that is, when it is caught in the ambiguity of an actualization, transformed into a term dependent upon many different conventions, situated as the act of a present (or of a time)..."[de Certeau 84]. Thus place becomes transformed into space by virtue of actions. It is human practices and operations, the ability to move things, that changes place into space. de Certeau: "*In short, space is a practiced place*". de Certeau exemplifies this transformation process by making an analogy with the way in which people walk through a modern city: "Thus the street geometrically defined by urban planning is transformed into a space by walkers. In the same way, an act of reading is the space produced by the practice of a particular place: a written text, i.e., a place constituted by a system of signs" [de Certeau 84].
Although de Certeau may not have been thinking of 3D-VWs when he created his concepts, they make more literal sense here than many other places. Designers and developers create a program which can generate a virtual 3D environment that is defined by a number of unique geographical characteristics and where the elements are defined by their common relationship to each other. An instant configuration of positions: ordered, stable, and without movement. In other words, a 'place' as de Certeau describes it. This 'place' does not come to life in a certain sense unless a user practices it. The space is first drawn in 3D graphics at the moment a user-in-avatar moves through it. Up to that point it is merely code. By practicing this 'place', the users (-in-avatars) turn it into a 'space'. Space arises as a result of the operations which situate and temporalize it, which are created as a result of interactions of mobile elements, as the totality of movement which unfolds within it, as the "unity of conflictual programs". Space is a practiced place. And 3D space is also a practiced place. Or, using de Certeau's reading metaphor: to move through 3D space is a kind of 'act of reading' that creates 'space' by practicing a particular 'place' – a written text, a program – a 'place' constituted by a system of signs or codes.
But the concepts are also relevant in another way. When de Certeau describes the city as a practiced place, where the trajectories of the inhabitants constantly define and redefine the city as space, he does it in the form of a duality where each inhabitant follows his own private agenda, but where all of these individual projects contrib-

ute to giving life to the city as a whole. The same is true of 3D virtual space understood as a more abstract social space. Each individual follows his own project and intentions here as well, but from the sum of all these individual paths and activities, a kind of virtual space arises – a city or a society.

'Tours' and 'Maps'

Another central point in de Certeau's presentation is that the complexity of daily life is often dealt with by using the help of spatial representations or spatial stories, in other words, stories that tell about space. This is an area that modern psychologists and cognitivists call 'cognitive mapping'.
Two types of description can be historically differentiated in relation to movement in space: an observational and an operational represented by 'the map' ("a plane projection totalizing observations") and 'the tour' or 'the itinerary' ("a discursive series of operations") [de Certeau 84]. The 'map model' describes space in observational terms: "The church is next to the city hall ...". The 'tour model' describes space in operational terms: "Turn to the right, then go straight ahead..." While this last type of description is based on a spatialized action, walking, the first is based on knowledge of how spaces are visually ordered in relation to each other seen from a raised perspective.
de Certeau mentions that the 'tour model' was the dominant way of recreating movement in space in pre-modern times, but that the scientific discourse in the process toward objectification has eliminated the tour model and given the advantage to the 'map model'. During the 15th century, f. ex., maps were based on 'tours', but they were later displaced by the synthesizing map model in order to describe locations.
The tour model still exists – and is still dominant – in the description of space in daily life. de Certeau refers to studies of how a group of New Yorkers describe their apartments. When faced with that task, a large majority of them chose the tour model, "You turn right and come into the living room..." in contrast to the map model, "The girls' room is next to the kitchen", etc. The tours were, for the most part, descriptions of the operations that must be carried out or the routes followed to 'come in' to each room.
These considerations and distinctions also appear to have relevance in relation to how users orient themselves in 3D-VWs. We can look at the daily formulations, set phrases and metaphors that we use – the stories we tell each other – when we speak of our travels in 3D virtual space. And why not use Mr. Avatar himself: DigiGardener – alias Bruce Damer – as a point of reference, when he explains and makes sense of 3D-VWs. Here is a sequence that introduces the Worlds Chat Space Station after we have landed in 'the gallery': "Turn to your immediate left and travel along the wall of portraits toward the corner window... Going back down the escalator from the pod, I discovered another doorway in the hallways around the hub. This turned out to be an elevator called, "Wather lift". I got in and pushed what seemed to be the down button. Sure enough, I went down and emerged into tunnels in the engineering deck below the hub" [Damer 98]. When it comes to describing 3D-VWs, the description is, thus, primarily based on the 'tour model'. Actually, Damer's whole book on 3D-VWs is, in principle, built up on the tour model. It is itself a guided tour which includes the presentation of 'The Tour Packages': "Now that you have had a chance to look over the destinations in the travel brochure, you are well equipped to choose your *tour package*. You can choose the trip that best suits you from the following roster, make up your own *itinerary*, or do it all and take *the Grand Tour of Worlds*. Bon Voyage!" [Damer 98, my emphasis].
However, Worlds Chat Space Station does also have a 3-dimensional 'map' of 'the space station' in a window in the bottom right corner of the screen where users actual placement is indicated by the a 'glow' in the respective section. This 3-D map can also be used for navigation, movement and transportation: by clicking on the map you are automatically teleported to the corresponding space. This is one of the unique characteristics of the new digital worlds: you can 'tour' directly from a 'map'.

Enunciation and Spatial Representation in 3D-Virtual Worlds

An issue of particular complexity in 3D-VWs is the question of: the mode of address/presentation and positioning of the user. This section will examine the relationship between spatial representations and enunciation since the hypothesis is that this will point out many of the medium's distinctive characteristics in general.
Media research usually differentiates between two levels of enunciation which are often called 'story' and 'discourse'. Here, discourse covers utterances which require a speaker and a listener (someone addresses someone else). In other words, it is always organized in a 'personal category' which includes an 'I' and a 'you' as well as it situates the enunciation in time and place: 'now' and 'here'. The discourse model is then the self-referential dialog of communication between people. 'Story' covers the simple statement of fact: the presentation of an objective and separate world of space and time inhabited by others (he, she, it); the impersonal text, where

events happen as produced, as they appear on the horizon of the story: 'then' and 'there'. In this case, there appears to be no narrator – the events seem to tell themselves.
Media and genre can usually be characterized in relation to the concepts: discourse and story. And such a characterization will often show a number of the medium's distinctive characteristics in general. Film presents itself as 'story'. A narrative space is created where the plot unfolds without the narrator being directly in the picture and where, f. ex., the 180 degree rule ensures that the viewer never physically becomes part of the story space via the camera's eye. There is a sharp separation between story space and viewer space. The telephone, on the other hand, is a strongly discursive medium with marked potential for the exchange of discourse. Here the 'I' takes responsibility for an utterance and expects an inter-subjective relationship with a 'you' and a 'here and now'. Finally, the TV has a middle position which to a large degree uses simulated eye contact (the camera) with the viewer and direct address in which the viewer is addressed as a 'you'. This discourse and conversation are of course simulated and fictive because TV is a one-way medium and the viewer, therefore, cannot participate in exchanges or be addressed as a subject, but only as an object. As the examples indicate, there is a connection between the media's spatial representations and the enunciation levels.
In many ways, interactive multimedia actualizes these enunciation levels. Multimedia uses both enunciation spaces. The interactive aspect often implies a form of discourse space. Distributed multimedia in particular has a natural potential for becoming strongly discursive, where the receiver is simultaneously the sender. On the other hand, the presentation of multimedia – f.ex. playing video, animations, showing pictures, texts – also implies a 'story space'. Many multimedia products constantly change between the two enunciation levels: the interaction sequences interchange with presentation sequences that can't be interacted with. (The problem with many bad multimedia products is precisely the lack of consciousness in regard to dealing with this shift in enunciation mode and the different receiver positions that thus disturb the experience produced.) These enunciation relationships are particularly complex in 3D-VWs. In these cases, interaction sequences can interchange with presentation sequences. However, it could also be said that the user (in-avatar) can move through 'story space' and perform as a character with others (without regard to techniques like the 180 degree rule). The avatar can even participate in various discursive spaces with other avatars. In reality, the user finds himself in front of a screen where he can observe (a representation of) himself participating in both 'discursive space' and 'story space' – partly as a partner and partly as spectacle.Thus, virtual 3D space creates experiences and forms of interaction which diverge markedly from previously known media and are in themselves very complex combinations of enunciation levels.
A set of concepts closely related to the above has to do with the point-of-view related to the presentation. We can speak of a first person view, a second person view and a third person view respectively. The first person view – or what film theory calls 'subjective camera' – is characterized by placing the point-of-view with the viewer as the participating subject in relation to the surrounding world. In other words, you see the world, the scene, actions through 'your own eyes' or rather: through the avatar's first person point of view. This means, among other things, that you can't see yourself or your own avatar (except perhaps using a virtual mirror). The only purpose of the avatar as a graphic representation is here to represent you in relation to other users. Examples of this first person view are: Worlds Chat Space Station, OnLive! Traveler and Black Sun Passport.
The second person view is closely related to the above. It has to do with the direct address of a 'you' to an 'I', from a second person to a first person. The best known example is probably the TV medium's talking heads with the direct camera view that simulates eye contact and the second person's direct address , but it can also be found in 3D-VWs. Several worlds recommend that you get in front of someone's avatar before beginning to chat with them. In OnLive! Traveler, the other avatar automatically turns to face you when you come close enough, without the person controlling the avatar having to do anything.
Finally, there is the third person view which is characterized by seeing the world – including yourself (your avatar) – from a third person's point-of-view. Here it is possible to look at yourself and your interaction with others in a kind of 'out-of-body' experience. A third person view can be found in The Palace (though only in 2D), WorldsAway (2.5-D) or when you see multimediastreams in a virtual world.
In AlphaWorld it is even possible for the user interactively to change viewpoint between first person point-of-view – to see the scene from your avatar's body – and third person point-of-view, to see the scene and your own avatar from a third position, f. ex. in the form of a "bird's eye" or "God view".

Social Interaction and Interpersonal Communication in 3D-Virtual Worlds

In this section, the key questions are: How does the virtual environment influence interaction? And how do various key characteristics of social interaction and interpersonal communication function in Virtual Worlds? A subhypothesis here is that just as interpersonal communication can be divided and described by a number of char-

acteristics, the same is true of mediated interaction in 3D-VWs. It also seems that the descriptive categories from the first can, to a large degree, be used in relation to the second, – in some cases the forms can be take over relatively directly, other cases require modified forms although even these modifications are significant in relation to the description of 3D-VWs. There are several different types of (virtual) interactions and simulated communication of interest in 3D-VWs, which can be represented by the following matrix [Fig. 1].

	(human) Actor	Designer-in-Avatar	User-in-Avtar	Bot (autonomous agent)	Objetcs	Environment
(human) Actor	Ac vs. Ac					
Designer-in-Avatar	D-in-A vs. Ac	D-in-A vs. D-in-A				
User-in-Avatar	U-in-A vs. Ac	U-in-A vs. D-in-A	U-in-A vs. U-in-A			
Bot (autonomous agent)	Bot vs Ac	Bot vs. D-in-A	Bot vs. U-in-A	Bot vs. Bot		
Objects	Ob vs Ac	Ob vs. D-in-A	Ob vs. U-in-A	Ob vs Bot	Ob vs. Ob	
Environment	En vs Ac	En vs. D-in-A	En vs. U-in-A	En vs Bot	En vs. Ob	En vs. En

Figure 1: Matrix of types of interactions in 3D-VWs

Due to limited space, the comprehensive area of virtual social interaction can only be hinted at in this context by using a few examples taken primarily from areas within interpersonal communication such as: spatial behavior and bodily contact. Spatial behavior, in this context, is of special interest for several reasons. Spatial behavior, such as proximity, are limited in real life (RL) by our natural abilities to send and receive signs. Within this framework, certain variation is possible and these variations make up significant signs in interpersonal interaction. These physical framework does not, however, always have the same necessity or relevance in 3D-VWs.

Proximity refers to the distance between two people. In real life, given cultures have relatively set standards for distance in certain social situations. E.T. Hall has f.ex. suggested that there are four zones in North America. 18 inches: for intimate relationships; bodily contact easy; can see but not very well; can talk in whisper. 18 inches – 4 feet: for close relationships; can touch other; can see better. 4-12 feet: for more impersonal relations, e.g. from behind a desk, and more independent work; louder voice needed. 12 feet and above: for public figures and public occasions. These distances are partly set by the physical frameworks of the human voice, body reach. F.ex., in order to interact with someone it is necessary to come near enough for speech to be heard and the face to be seen. In 3D-VWs this physical framework is no longer a valid necessity. Even so, part of real life proximity is still upheld. OnLive! Traveler encourages users to get as close as possible and to turn their faces toward other avatars before speaking to them.

There are, however, also situations where there is a marked difference. In many 3D-VWs one avatar can 'whisper' to another avatar – send a personal message to just one person – without any of the others present being able to hear it. This is the case, f. ex. in Worlds Chat, The Palace, WorldsAway, and Black Sun Passport. This whispering is not, as in RL, dependent upon the physical distance between the two avatars. Actually, the two avatars don't even have to be in the same 'room' while whispering to each other.

However, proximity is not only a 'steady state'. Changes in proximity can be interpreted as social signs in interpersonal communication. In many 3D-VWs being approached in physical distance – as in RL – is considered either aggressive and threatening or intimate and sexual behavior. This area overlaps with another large area within interpersonal communication: bodily contact.

Bodily contact is considered within interpersonal communication to be the most elemental form for the social communication of interpersonal attitudes. In avatar-cyberspace a number of special types of interpersonal digital body language have arisen. In certain virtual worlds it is possible to go through another avatar (and in this way achieve negative proximity – less than 0). There are worlds where going through another avatar isn't considered an insult (Active Worlds, Ground Zero: The Gate) and worlds where it is tolerated if it isn't done on purpose, an apology is given and the view of conversations in progress is not blocked (Worlds Chat). In other virtual worlds like OnLive! Traveler, avatars cannot go through each other, but bump into each other's bodies on contact. These bumps are often considered aggressive and socially unacceptable behavior and avatars that do it intentionally are socially stigmatized as 'Headbangers'.

Proximity also acquires a new and different meaning and function in 3D-VWs. An avatar's 'aura' is usually the term for the area around an avatar. It describes the space around the representation which is visible just as it determines when other avatars in the room are made aware of a given avatar's presence. Proximity – distance from one avatar to another – determines who can be seen and paid attention to and thereby directly and deci-

sively determines the possibilities for interaction. There can also be a number of other conditions and limitations connected with the 'aura'. In Worlds Chat, only chat from the six closest avatars can be seen. In other 3D-VWs, certain rooms can only hold a limited number of avatars so that the next arrival is placed in another copy of the room. Here it is possible – in absolute coordinates – to be very close to another avatar without being able to see it because it is in another 'copy-room'.

Conclusions & Perspectives

The paper has both analytical, theoretical, methodological, and practical implications. The paper is of interest in relation to the analytical and theoretical understanding of this rapidly growing part of virtual reality and mediated human interaction, and in relation to methods of examining these universes. The observations from this paper should also have an effect on conventional theory formation and understanding within (multi)media research, communication studies, sociology, etc. But it also has implications for the construction aspect since the design of new 3D-VWs, virtual settings, avatars, etc. must be based on actual knowledge of the conditions and possibilities for virtual interaction and communication, concerning questions such as: Which parameters are significant and therefore imperative to represent?
The paper only deals with a small part of the field covered by interpersonal interaction and communication. Other aspects of virtual interaction in 3D-VWs must be seen in a widere, futuristic perspective and be thoroughly analyzed. This includes areas such as: the sequence of events, the initialization and closure of communication, turn taking, appearance, gestures/kinesics, posture, eye movement and eye contact, facial expression, structuring of space and time, conflict patterns, non-verbal communication, communication functions such as phatic communication, meta-communication, transaction structures, participation structures, etc.
So, why not let E.A. Abbott have the last word: "" Either this is madness or it is Hell." "It is neither," calmly replied the voice of the Sphere, "it is Knowledge; it is Three Dimensions: open you eye once again and try to look steadily." I looked, and, behold, a new world! There stood before me, visibly incorporate, all that I had before inferred, conjectured, dreamed, of perfect Circular beauty ... I could see ... a beautiful harmonious Something – for which I had no words, but you, my Readers in Spaceland, would call it the surface of the Sphere ... "I come," cried he, "to proclaim that there is a land of Three Dimensions." ... "The time is short, and much remains to be done before you are fit to proclaim the Gospel of Three Dimensions to your blind benighted countrymen of Flatland."..." [Abbott 1884].

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Web Based Practice Environments to Teach Mechanical Skills

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Abstract: This presentation demonstrates 3-Dimensional (3-D) practice environments developed to teach mechanical skills. The instructional strategy integrates multimedia Computer-Based-Training (CBT) with a structured 3-D practice environment and a virtual 3-D practice environment. The multimedia CBT and 3-D practice environments can be delivered via the Web using Web browsers on a corporate local area network (LAN) or the Internet. The multimedia CBT and structured 3-D practice environment were implemented for traditional CBT delivery and were converted to Web delivery. The virtual practice environment is a desktop Virtual Reality 3-D practice environment that was implemented with the Virtual Reality Modeling Language (VRML) and Java for Web delivery. Realism is added to the multimedia CBT and practice environments by using 3-D Computer Aided Design (CAD) models as the source for images, animations, and user-controlled objects in the practice environments.

Instructional Strategy

Training mechanical skills requires developing the cognitive, perceptual, and motor skills of the maintenance technician. The maintenance technician must be taught to visualize the complex relationships between mechanical components, diagnose problems, and perform corrective actions. Demonstrations, simulations, performance based laboratory exercises, and on-the-job-training (OJT) in an apprenticeship program are typically used to teach mechanical skills. These techniques emphasize the development of motor skills but do not adequately address the perceptual skill development needed to become an expert.

Multimedia CBT techniques with realistic 3-D practice environments appears to offer a natural solution for improving the perceptual skills of maintenance technicians. Practice is extremely important in the development of perceptual and mechanical skills. Perceptual skills are improved by giving the technician a practice environment to explore and experiment with the mechanical system. The instructional strategy is shown in Figure 1.

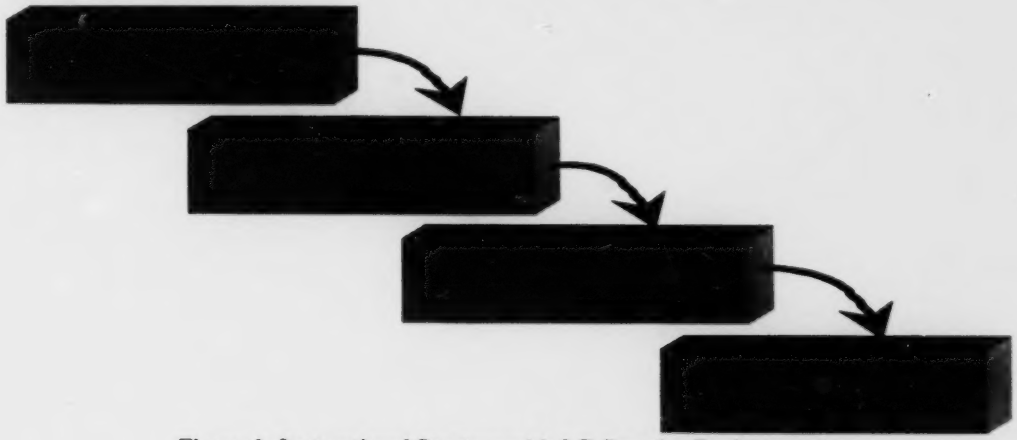

Figure 1: Instructional Strategy with 3-D Practice Environments

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Multimedia CBT

The instructional strategy uses multimedia CBT techniques to teach basic concepts, demonstrate problem solving approaches, and demonstrate performing corrective actions for the technician. The multimedia CBT can be distributed using traditional CBT delivery techniques or can be delivered via the Web with a Shockwave server and a Web browser with the appropriate plug-in. The instructional designer defines the animations and illustrations needed to train basic concepts. Renderings and animations using 3-D CAD models are heavily used to portray realistic situations to the technician. Figure 2 is a multimedia CBT example showing the use of 3-dimensional animations to illustrate the complex relationships between the mechanical components and tools for typical a shaft alignment situation. The animations in Figure 2 provide the level of detail needed to show the shafts, couplings, tool mounting brackets, and the dial indicator.

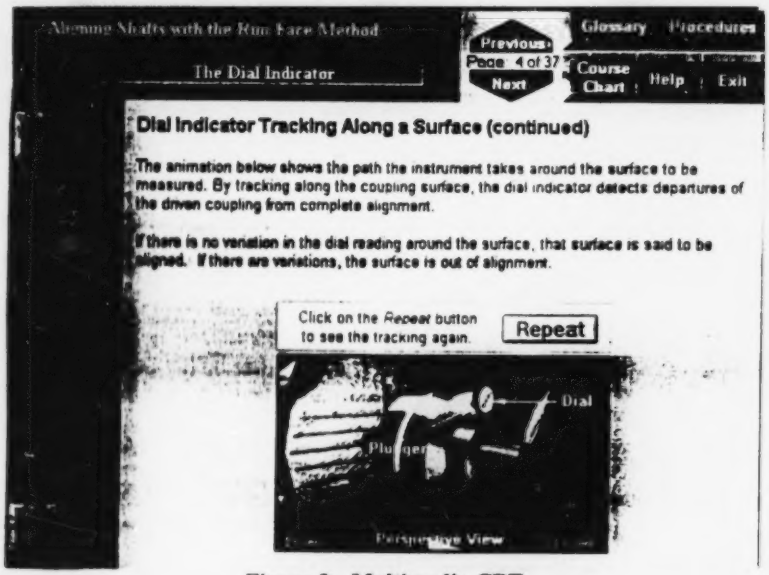
Aligning Shafts with the Rim Face Method
The Dial Indicator
Previous
Page 4 of 37
Next
Glossary
Procedures
Course Chart
Help
Exit
Dial Indicator Tracking Along a Surface (continued)
The animation below shows the path the instrument takes around the surface to be measured. By tracking along the coupling surface, the dial indicator detects departures of the driven coupling from complete alignment.
If there is no variation in the dial reading around the surface, that surface is said to be aligned. If there are variations, the surface is out of alignment.
Click on the Repeat button to see the tracking again.
Repeat
Dial
Plunger
Perspective View

Figure 2: Multimedia CBT

Practice Environments

Once the technician has learned a concept with multimedia CBT, he practices solving related problems in the structured 3-D practice environment. After the technical has mastered problem solving in the structured practice environment, he enters the virtual 3-D practice environment to practice more realistic and advanced mechanical skills. The primary difference between these two practice environments is the amount of freedom the technician has to interact with and explore the objects in the environment. The structured practice environment guides the technician during problem solving activities whereas the virtual environment is a free, exploratory environment with limited guidance. The objects in the virtual practice environment have more realistic and dynamic behaviors.

Structured Practice Environment

The structured practice environment can be distributed using traditional CBT delivery techniques or can be delivered via the Web with a Shockwave server and a Web browser with the appropriate plug-in. In the structured practice environment, the technician's interactions with the tools and equipment have been designed by the instructional designer to teach a specific concept and allow the technician to practice performing a specific task. The viewpoint of the 3-D structured practice environment has been specifically designed to support the concept

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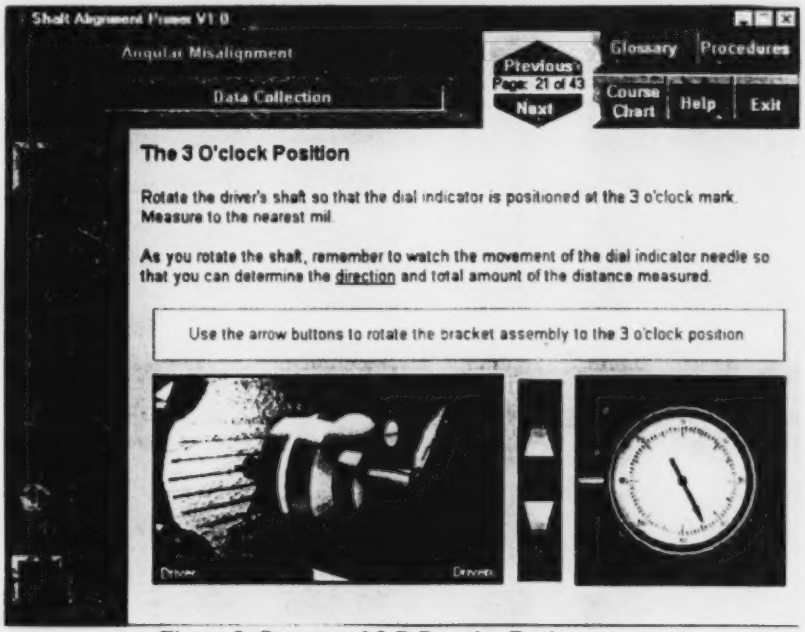
being trained. The actions performed by the technician are limited to support the concept being learned and the actions being practiced. The technician is not able to freely explore the situation -- this is the power added by the virtual practice environment once the technician has mastered the skills taught in the structured practice environment.

Figures 3 and 4 illustrate practice sessions in the 3-D structured practice environment. When taking measurements with the dial indicator, the technician is taught to relate the round coupling face to a clock face. The technician uses 12 o'clock as a reference point by zeroing the dial indicator and taking measurements at the 3, 6, and 9 o'clock positions.


Angular Misalignment
Data Collection
Previous
Page: 21 of 43
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Glossary
Procedures
Course Chart
Help
Exit
The 3 O'clock Position
Rotate the driver's shaft so that the dial indicator is positioned at the 3 o'clock mark. Measure to the nearest mil.
As you rotate the shaft, remember to watch the movement of the dial indicator needle so that you can determine the direction and total amount of the distance measured.
Use the arrow buttons to rotate the bracket assembly to the 3 o'clock position

Figure 3: Structured 3-D Practice Environment

In Figure 3, the technician uses the interactive controls to rotate the animated dial indicator instrument from the 12 o'clock position to the 3 o'clock position to take the first reading. The technician must watch the dial indicator face closely to

- determine the rotation direction. The arithmetic sign of the reading is positive for clockwise rotation and is negative for counterclockwise rotation.
- count multiple rotations of the dial indicator needle which have to be factored into the reading.
- look for the dial indicator needle rotation to change directions. An arithmetic sign change occurs for the reading if the needle crosses the reference point while rotating in the opposite direction of the last reading. If the previous reading had multiple rotations of the needle, the reference point is only crossed after rotating in the opposite direction for the same number of rotations.

When the technician has rotated the dial indicator to the correct position, a message is displayed asking the technician for the reading. The technician's readings are accumulated in a measurement worksheet so that he can analyze his measurements to determine the type of misalignment and compute the amount of correction needed. Feedback is provided for correct and incorrect measurements as part of the structured training process. This technique is also used for the technician to practice taking the 6 and 9 o'clock readings and completing the interactive worksheet.

A problem solving session is shown in Figure 4. The technician uses the measurements he has recorded in the worksheet to analyze the type of misalignment and determine the amount of correction that needs to be applied to

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the motor. Random problems can be generated in the structured practice environment so that the technician can practice a wide variety of problems.

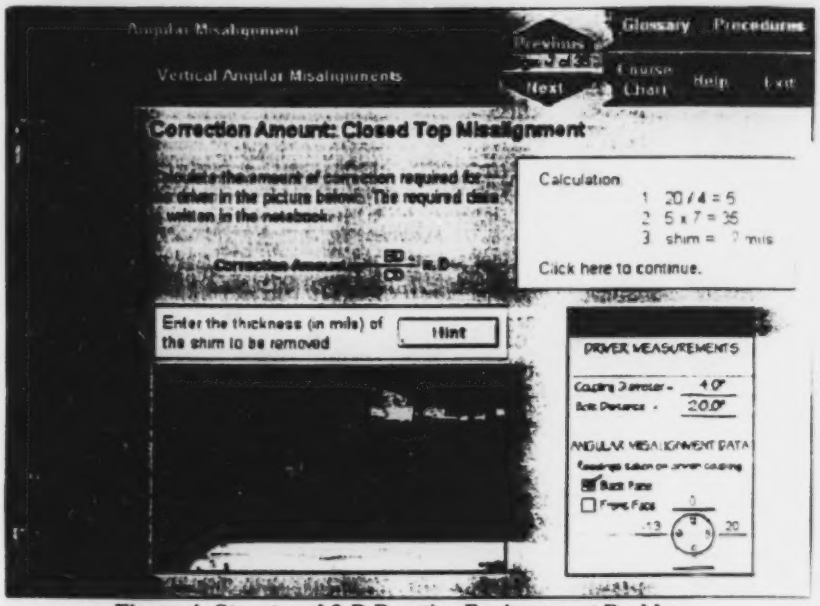

Figure 4: Structured 3-D Practice Environment Problem

Virtual Practice Environment

The virtual practice environment is delivered via the Web with a Web server and a Web browser with the VRML 2.0 plug-in. The virtual 3-D practice environment provides a more realistic practice environment for the technician. The technician interacts with the tools and equipment in a more natural manner than in the structured practice environment. The technician can freely interact with the tools and equipment while solving problems. The technician is free to move around a 3-D scene composed of realistic equipment and tools rendered from 3-D CAD models. The technician is totally in control of his viewpoint in the 3-D scene. The current virtual 3-D practice environment is implemented with Virtual Reality Modeling Language (VRML) scenes with JavaScript and Java code added to provide more realistic equipment behaviors and problem-solving practice for the technician.

Figures 5 and 6 illustrate two approaches to problem-solving in the virtual 3-D practice environment. In Figure 5, the virtual 3-D practice environment is a complex VRML scene composed of a pump, a motor, shafts with coupling housing between the pump and motor, the coupling gaskets, and a properly mounted measuring instrument (dial indicator) with mounting brackets. This figure shows the Right Viewpoint. Other available Viewpoints are the Left, Top, Bottom, Front, and Back. The technician can also zoom closer to areas of interest. This VRML scene is very complex and navigation can be sluggish for the interactive user.

In the virtual practice environment, the technician can explore the mechanical system using standard VMRL browser capabilities. The exploratory power of the browser is greatly expanded by using 3-D CAD models to generate the VRML objects. The full detail of the internal components of the mechanical system is available for exploration. VRML sensors and interpolators, JavaScript, and Java are used to add complex behaviors to the objects in the scene. With these more complex behaviors, the technician can practice taking the system apart and re-assembling the system. The technician can explore unseen components such as the coupling gasket inside the coupling housing on the shafts.

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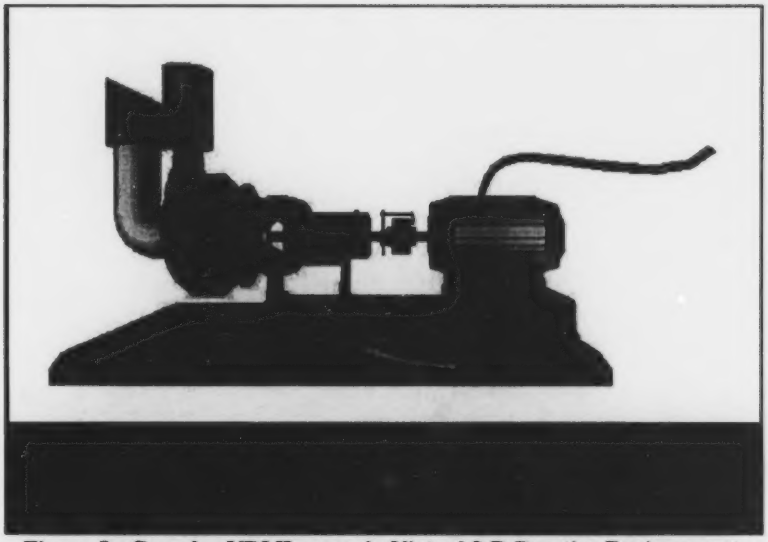

Figure 5: Complex VRML scene in Virtual 3-D Practice Environment

The virtual 3-D practice environment scene can be simplified to allow the technician to work with a subset of the mechanical system. With this simpler scene, the technician can practice mechanical skills before practicing on the full mechanical system. In Figure 6, the complexity of the virtual 3-D practice environment is reduced to the shafts with the coupling housing and the dial indicator with mounting brackets. The VRML file size for this simple scene is larger than most VRML files. In this scene, the technician can grasp and move the dial indicator, mounting brackets, and the shafts. VRML sensors and interpolators, JavaScript, and Java can be used to add complex behaviors to the objects in the scene. With these more complex behaviors, the technician can practice assembling the mounting brackets with the dial indicator and placing the brackets on the shafts.

Figure 6. Simple VRML scene in Virtual 3-D Practice Environment

VRML Experience

VRML offers the ability to display and interact with 3-D objects using a VRML capable Web Browser. A VRML object is a geometric representation of a real-world object. Most of the standard 3-D CAD model formats can be translated into VRML objects and displayed by a VRML capable Browser. A VRML scene is the placement of the

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VRML objects in the virtual environment. A VRML capable Web Browser provides a user interface for viewing and walking around a scene composed of VRML objects. Users can interact with objects that have dynamic behaviors.

A simple virtual 3-D practice environment can be created using VRML objects and scenes. VRML scenes can add value to the mechanical skills training environment by providing a realistic 3-D virtual environment. The main advantages we have found are

- Existing 3-D CAD models can be converted into VRML objects and placed in VRML scenes. This re-use of CAD models reduces the cost of creating VRML scenes and provides a smoother transition between the practice environments and the real world.
- Animations and behaviors can be added to the VRML objects in a scene to provide simple user interactions and improve scene visualizations. Java can be used to add complex behaviors that mimic realistic user actions and equipment behavior.
- Navigation by walking around the mechanical components can provide a tremendous improvement in the user's understanding of the relationships between the components.
- Viewpoints can provide a tremendous improvement over our 3-D structured practice environment. We implemented 6 standard viewpoints: Front, Back, Left, Right, Top, and Bottom. These viewpoints provide a rapid navigation mechanism from one view to another view and alleviate some of the technician's frustrations with sluggish navigation for complex scenes. The interactive user can quickly improve their understanding of the mechanical components by exploring with the viewpoints.
- Zoom and pan functions provide an improvement over our 3-D structured practice environment. The interactive user can quickly zoom to investigate areas of interest.

The disadvantages we have found are

- The VRML scenes that use 3-D CAD objects are very large. The VRML browsers take a long time to load the scenes and browser navigation can be sluggish.
- Realistic user interactions in the practice environment cannot be implemented purely with VRML. Other programming languages, such as Java and JavaScript, must be used to implement the user interactions and sophisticated dynamic behaviors.
- Spatial orientation is difficult with the browser user interface. It is very difficult for an interactive user to select and accurately place objects in 3-D scenes using VRML sensors and interpolators. Java must be used to implement the behaviors required for realistic spatial orientation activities.

VRML seems to provide a natural path for implementing an affordable, realistic virtual 3-D practice environment. Although we have encountered disadvantages with the current technology, we believe that VRML technology will improve dramatically in the next few years. We are going to integrate our isolated VRML objects and scenes into a practice environment with problems and feedback. We are going to continue to investigate the user interactions and behaviors required for a realistic virtual 3-D practice environment. The approach we are pursuing is integrating VRML objects with Java to implement more realistic capabilities for the practice environment.

Summary

This paper describes an integrated instructional strategy using multimedia CBT, a structured 3-D practice environment, and a virtual 3-D practice environment. The multimedia CBT and structured practice environment can be delivered via the Web or using traditional CBT delivery techniques. The virtual practice environment can only be delivered via the Web using a Web server and Web browsers. These practice environments were developed to teach mechanical skills for precision shaft alignment using the "Rim-Face" dial indicator method. The objective of our current research is to develop an affordable virtual 3-D practice environment to augment the training and practice provided by multimedia CBT and the 3-D structured practice environment. We are continuing to investigate VRML and Java approaches to implementing a virtual 3-D practice environment. We hope that the techniques described in this paper will encourage other training developers to consider the benefits of 3-D practice environments for mechanical skills training.

About the Author

Janet Faye Johns is a Principal Engineer at The MITRE Corporation where she is responsible for software systems design and development. Ms. Johns has a B.S. in Mathematics, an M.S. in Math and Computer Science, and has completed the coursework for a Ph.D. in Computer Engineering. Ms. Johns has been the vice-chair of the Association for Computing Machinery (ACM) Special Interest Group for Ada (SIGAda) Artificial Intelligence Working Group (AIWG) since 1990. She frequently teaches tutorials on the design and development of Artificial Intelligence applications. Ms. Johns was the Product Manager for the Shaft Alignment Primer which was developed to investigate how interactive multimedia could be used to teach mechanical skills. Ms. Johns may be reached by phone at 617-271-8206 or by e-mail at jfjohns@mitre.org.

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A Benchmark Suite for Electronic Commerce

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Abstract: This paper discusses preliminary project work on the specification and implementation of a benchmark suite of electronic commerce applications. Electronic commerce applications extend the traditional notion of a database transaction through cooperation with the web browser, the tight incorporation of transmission and login access security protocols within the database web transaction and through increased distribution of functionality. We show how e-commerce application requirements interact with an emerging business model for combined business-to-business and business-to-consumer e-commerce. In addition, we suggest that the underlying development technologies influence the performance of e-commerce application or commerce server. Finally, we propose to create several e-commerce benchmark specifications based on different business models.

1. Introduction

The project identifies that electronic commerce (e-commerce) database transactions differ from conventional database transactions in three main ways. Firstly, the browser must take part in the notion of a transaction for non-deferred delivery mechanisms. The browser should take part in fault tolerance protocols even if it is in the form of a simple acknowledgment. For example, consider the following commercial transaction scenario. A user's electronic cash is debited in return for display of a magazine from a virtual newsstand, but the browser fails before the user can view the contents of the magazine. In a transactional environment, the transaction must abort and be rolled back such that the user's account is re-credited. Therefore a System Under Test (SUT) specification for the e-commerce benchmark application must be extended to include the Web browser.

Secondly, greatly enhanced security measures (e.g. encryption, SSL (Secure Socket Layer)) are required for e-commerce transactions. The security protocol must be integrated within the web database transaction. SSL is required between the client browser and the business's web server, whereas other encryption technology is needed between the web server and any Internet database servers.

Thirdly, electronic commerce transactions can be fully distributed in the rapidly emerging business models for e-commerce. Electronic Commerce applications can potentially generate work in parallel on different databases at potentially remote sites. For example, one may want to verify a customer's credit from a financial institution such as a bank, at the same time that access is made to several separate and remote suppliers' databases to ascertain supply quantities and prices. We specify transactions in the Extranet benchmark to accommodate this scenario.

This short paper is organized as follows. Section 2 describes an emerging business model for e-commerce that leverages value-chain strategies. Section 3 discusses the main underlying technologies for e-commerce applications. Section 4 provides a brief summary.

2. E-Commerce Business Model

Only one business model can be used per benchmark specification. There are many business processes that can be tweaked and/or interchanged to create alternative business models. This section illustrates an example business model: a possible e-broker model as shown in Figure 1. The e-broker model incorporates access to

databases internal to the company and to the external databases of some other partner companies. Partner companies are defined here as those companies with which a company conducts business transactions and holds trusted relationships. We assume that the company's suppliers are partner companies. That is, the suppliers are not identified through an intelligent web agent but that the suppliers are trusted and well known. We also assume that security is implicitly incorporated in the form of SSL (Secure Sockets Layer) and encryption technology within the electronic commerce application itself and that one of the supported payment method is the credit card option. Delivery of goods is not immediate but through a third party delivery company such as Fedex or UPS.

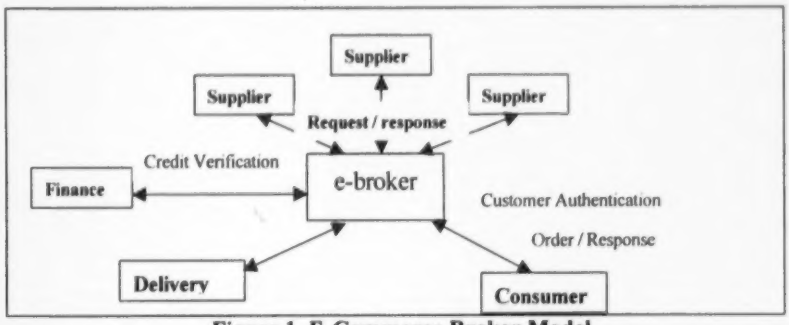

Figure 1. E-Commerce Broker Model

3. E-Commerce Technologies

The three main platforms used in writing distributed applications for the Internet are the Java base classes and APIs, Microsoft's (Distributed) Common Object Model ((D)COM) and Active Server Pages, and OMG CORBA Distributed Computing Environment with Object Transaction Services (OTS) [Benda 1997]. Since the performance of the electronic commerce application is dependent on its underlying technology, we plan to create canned versions of an electronic commerce benchmark based on each of the above models. Benchmark versions must also cater for differences in database connectivity solutions such as ODBC (Open Database Connectivity), JDBC (Java Database Connectivity) and Microsoft's ActiveX Data Object technologies.

A matrix is shown in Table 1 to illustrate the electronic commerce benchmark versions and their areas of application.

Technology	Intranet	Extranet
Microsoft's ASP/IIS/MTS	Yes	Yes
CORBA OTS	Yes	Yes
Java Virtual Machine, APIs and base classes	Yes	Yes

Table 1. Versions of an Electronic Commerce Benchmark

4. Summary

A benchmark is a standard for measuring and comparing the performance of like systems. A benchmark can provide important statistical information so products can be fine-tuned before their deployment. For end users, on the other hand, a benchmark can be used to compare the strengths and weaknesses of different products for effective IT planning.

E-Commerce benchmark specifications, due to their heterogeneity, will be different from all other technological benchmarks which have been heretofore single component based (e.g. TPC-C, WebSTONE). The multitude of components in an e-commerce platform makes development of specifications and instrumentation of implementations that much more challenging.

5. Reference

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Database Supported German Language Learning System on the WWW

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Abstract: This paper introduces a database supported German language learning system on the WWW. Our system uses a server side database facility to create a variety of teaching pages. This database facility creates several different pages from a few course templates and many multi-media materials such as words, phrases, sentences, sounds of pronunciation, movies and so on. The facility reduces the cost of authoring, and increases students' interest in the teaching pages. In addition, we use what is called the LiveConnect facility to integrate these individual multi-media materials on a page into monolithic teaching materials. The database facility is also used for acquiring and evaluating students' learning activities. The facility helps the teacher to identify the problems of each student.

1 Introduction

Learning foreign languages is one of the most popular areas of study in Universities. The German language is learned by many students as a second foreign language in Japanese Universities. However, learning German is not easy for Japanese students because learning opportunities and learning materials are not readily available in Japan. Learning English on the other hand is much easier in Japan. English books and movies are imported continuously, so students have many opportunities for reading and hearing the English language in their day to day lives. The importation of German books and movies, however, is very rare. Even if they are imported, they are imported as a form translated for English or Japanese.

In order to create an efficient learning environment for the German language, we plan to use the excellent computing resources at our University. Our University is constructed of two faculties, "Computer Science and Systems Engineering" and "Engineering", both of which have large computing resources and a number of terminals. In addition, the Information Science Center at our University provides more than five hundred terminals for students. Therefore, our students have many opportunities to use these computer terminals anywhere on campus.

We have been working on a project to improve the German language learning environment by using these rich computer resources. In this paper, we introduce an overview of a German language learning system on the World Wide Web (WWW). The system we introduce in this paper uses a server side database facility to create a variety of instructive pages. This database facility creates several different pages from some course templates and multi-media materials such as words, phrases, sentences, sounds of pronunciation, movies and so on. The facility reduces authoring costs, and increases student interest. In addition, we use the LiveConnect facility to integrate these individual multi-media materials on a single page into monolithic teaching materials. The database facility is also used for monitoring and evaluating students' learning activities. The facility also helps teachers to deal with individual student concerns.

2 Skill of Students Assumed and Learning Materials

The students of our system we assume are beginners in the German language. The purpose of our learning system is to teach an introduction of the German language:

(1) Basic words
(2) Basic sentence structure
(3) Pronunciation
(4) Greetings
(5) Self-introductions
(6) Sentences for basic communication

Our system provides German language instruction courses that are developed and based on a drill and practice method for students. As shown in Figure 1, a course is constructed of several lessons, and each lesson has an explanation, a practice, and a test section respectively. The explanation section introduces the basic concept of the lesson. The practice section provides many exercises for comprehension. The test section provides an examination for evaluating the results of learning. In this course, only the students who pass the test section of one lesson can try the next lesson.

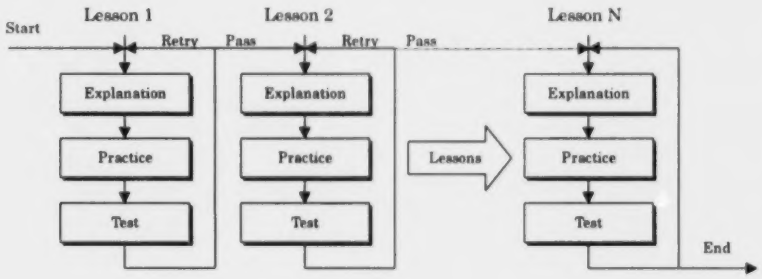

Figure 1 Learning Flow of Course

3 Requirements for The Leaning System

At the beginning of this project, we analyzed what requirements would be necessary for a German language learning system. This chapter shows the results of this analysis.

3.1 Network Based Learning System and Machine Independence

Conventional learning systems for computers are constructed for stand-alone computers, instead of for network computers. These systems, however, have many drawbacks as shown below:

(1) It is difficult to distribute and update learning materials for many computers.
(2) System distribution is restricted because these systems are dependent on an Operating System.
(3) Service hours and the locations of learning systems are limited.
(4) It is difficult for students to get prompt help from their teacher.
(5) It is difficult for teachers to know each student's degree of progress.

In order to resolve the above drawbacks, we believe that a learning system has to be developed as a network application. Moreover, we believe that WWW technology is the most suitable for our learning system. On the WWW, all of the contents are distributed on an on-demand basis. The distribution mechanism avoids contents distribution and update problems. Applications built on the WWW have no dependency on an Operating System or on hardware architecture. Students can access the WWW based learning server at any time and from any location. Therefore, opportunities for such learning have no limitations. We believe that the learning system has to offer a bi-directional communication facility between students and their teachers, and a network oriented system such as the WWW can offer this facility.

3.2 Variety of Learning Materials

As described in chapter 2, each lesson is constructed from three sections: an explanation, a practice exercise, and a test. The explanation section introduces the basic concepts of a particular theme, and the concept is fixed lesson by lesson. Therefore, the description of an explanation section would be fixed, and the authoring effort would be limited. However, the practice section should provide many exercise opportunities for the students. It should also contain a variety of different pages that students could try, but this would leave much of the authoring effort to the teacher. In order to avoid this authoring problem, we must introduce a method that creates many pages automatically, thereby reducing the authoring costs.

3.3 Multi-media Materials and Their Integration

One of the primary objectives of our research is to develop a multi-media German language learning system. Multi-media based learning is extremely effective for language learning, especially for the beginner. Presently, Japanese students do not have enough opportunities to hear the sound of native German speech or to experience German culture. In order to make up for these lacks in opportunity, our learning system must provide multi-media based learning materials for students.

WWW browsers have the ability to handle multi-media materials such as texts, pictures, sounds, and movies. However, each piece of multi-media material basically exists independently on a page, and there is no relation between these multi-media materials. This lack of the relation reduces the advantages of using multi-media materials for learning. This means that, learning materials must have an interactive function whereby a student can click a text on a page, thereby causing the playback of the pronunciation for the text. If we cannot control the relation between a text and a sound, however, we cannot realize this interactive function.

As described above, it is very important to integrate multi-media materials tightly on a single page.

3.4 Personalizing

Network based learning systems are used by many students on many distributed sites, and teachers cannot monitor all of their activities. Therefore, managing all the individual pieces of information for each student is very important in order to achieve an appropriate teaching level for each individual student. The learning system should manage the information shown below:

(1) Student identification information such as an account name and a password
(2) Degree of progress
(3) When and which lessons are completed
(4) How many times each lesson is learned
(5) Score on tests (Includes detailed information)

These personalized information records can help students manage their learning activities at their own pace. This information can also be used to control the flow of lessons and to offer the most suitable learning materials.

3.5 Evaluation of Learning

An evaluation of learning is important for both students and teachers. The students need the an evaluation to know their achievements. The teachers need an evaluation to provide feedback to their students. The evaluation is performed by using a test. Therefore, the learning system must also have an ability to mark the test.

In the case of a student passing the test on the first try, the student does not take the test again. On the other hand, when a student does not pass a test the first time, the student will take it as many times as is necessary until he or she passes the test; in this situation, in order to evaluate the ability of a student correctly, the questions on these tests should be similar, but must not be identical. The learning system must have a facility that generates these questions automatically.

3.6 Class Management

Networked CAI systems would be used by many students, therefore class management facilities for teachers are also important. The information that teachers must have is divided into two categories. One of these categories is information about individual students. The other is information about overall learning statistics for students.

Information about an individual student is used for the evaluation of a learning activity for that student. The information required for this purpose is similar to that shown in section 3.4 . Information about overall learning statistics for students is used to identify potential problems in the learning course. For example, if a few students do

not understand a part of a lesson, it is a problem for these students. On the other hand, if several students do not understand a part of a lesson, it indicates that the structure or content of the learning course has some drawbacks. This information would then be used to improve current learning course materials

In order to help with this kind of identification, the learning system should provide statistical information.

3.7 German Specific Letter Handling

A simple but very serious problem exists in the implementation of a German language instruction system in Japan. The problem is that standard computer systems such as the Japanese version of a Windows95 based machine, cannot handle German orthography. The standard Japanese computer system can input and display only Japanese and English letters. For instance, our systems have no German specific fonts and no German specific key-top assignments on keyboards. Therefore, the first thing we have to do in our project is to implement a German letter display and input system.

4 Implementation

4.1 System Overview

In order to satisfy the requirements described above, we have been constructing a system based on WWW technology. WWW technology can resolve problems about the machine dependency of a learning system and system distribution. This WWW technology can also support distance learning, with which there are no limitations on learning times or locations.

The system is constructed from three parts, WWW browsers for students, WWW browsers for teachers, and the WWW server, and each part is constructed from some sub-systems respectively. The system overview is shown in Figure 2.

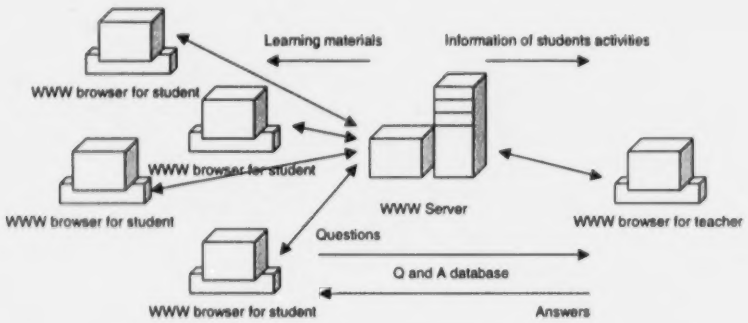

Figure 2 Overview of German Language Learning System

We have been using the Internet Information Server (IIS) as a WWW server that works on the Windows NT Server. It was selected because the IIS has an excellent database connectivity called the Active Server Pages. The Active Server Pages provide powerful functionality for the WWW pages. We use this facility not only to create a variety of pages for practices, exercises, and tests, but also to get statistical information about students.

We do not restrict the kind of browsers that we work with. However, the browsers we use with our system must have the abilities shown below:

(1) Multi-media playing
(2) Java Execution (for German Letter handling)
(3) JavsScript Execution (for multi-media integration)
(4) LiveConnect facility (for multi-media integration)

These requirements for browsers shown above are for the standard ability of modern WWW browsers.

4.2 Integration of Multi-media Materials

On a modern WWW browser such as Netscape Navigator, multi-media materials can be integrated by the LiveConnect facility. The LiveConnect facility creates a relationship between multi-media materials on a WWW page.

The author of a learning material can control the relationship between multi-media materials and can realize interactive functions by using JavaScript.

On a WWW browser, several kinds of multi-media data have an interface for the LiveConnect facility, and the interface is implemented on WWW browsers as a standard function. However, this interface facility is not enough to create integrated interactive learning materials. In order to avoid this limitation, we have developed some Java applets to introduce the rich LiveConnect facility to multi-media materials. These Java applets have enough interfaces for the LiveConnect facility and can be controlled by JavaScript.

4.3 Server Side Database

A database plays an important role in our learning system. Many fundamental functions of our system shown below are realized by the database facility.

(1) Student account management
(2) Generation of practice pages
(3) Generation of test pages
(4) Lesson flow control
(5) Question and answer support
(6) Statistics of a class

We use Active Server Pages (ASP) technology for the Internet Information Server (IIS) to employ the facility of the database. The ASP provides a server side database facility to WWW applications. The ASP facility creates a variety of HTML pages based on template files and the contents of a database. The database facility of the ASP is controlled by scripting languages such as VBScript and JScript, and the scripts are described on template files. An overview of the server structure is shown in Figure 3.

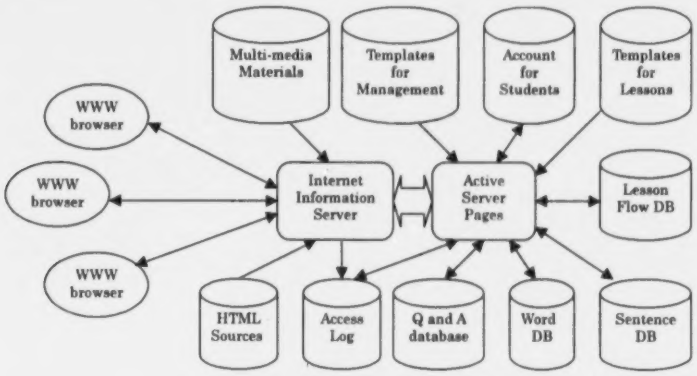

Figure 3 An Overview of Server Structure

A learning system contains programs and data. The programs of this system are described in template files using VBScript. When a template file is accessed by a browser, the program on the template file is executed by the ASP facility. This program will access a database to create an appropriate HTML page as learning material.

The data of this system is stored in databases. For example, word and sentence databases have such information as shown below:

(1) Related lessons
(2) Spelling
(3) Meaning in Japanese
(4) Information for practice and test generation
(5) Referencing for pronunciation
(6) Referencing for pictures
(7) Referencing for movies

The databases store only textual information. The multi-media information described above is stored in the form of an individual file in the WWW server.

Several kinds of practice and test pages are generated automatically based on this information and on programs in template files.

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4.4 Management of Student Information

A personalized function is realized by the Session Object of the Active Server Pages facility. At beginning of every session, the learning system confirms the right of a student to use the system by checking an account name and a password. The account information has been managed during the session by the Session Object.

The outline of students' activities is logged by IIS as standard access records of the WWW server. In addition, the details of students' activities required for student management is logged by ASP. In order to log this information, a script for logging is described in the template files. These logs are stored in the form of tables, and they can be referred to by SQL statements to analyze activities for an individual student and statistics for all of students. These SQL statements are described in template files for management purposes.

4.5 German Letter Handling

In order to realize German language handling on computer systems in Japan, we have developed a special program. This program is implemented as a Java applet for achieving machine independence. The applet uses a text as a parameter, and the applet displays the text as a German text. The applet has its own font shapes for German letters to display German texts. We have defined a special character sequence for the internal expression of German letters. For example, "ä" is expressed as "~a" in the parameter of the applet. An HTML description for a German text and the output are shown in Figure 4.

```
<APPLET CODE="GermanText.class">
<PARAM VALUE="Ich hei~se Doris Bergman.  Ich komma aus M~unchen."
</APPLET>
```

(1) HTML Description for a German Text.

Ich heiße Doris Bergman. Ich komme aus München.

(2) Displayed German Text.

Figure 4 German Text Expression and Display.

5 Conclusion

We have introduced a database supported German language learning system on the WWW. The system we have developed has an advantage in that the system can create several practice exercises and test pages from a few template files by using a database, and this facility helps both teacher and students. We will put this learning system into practice, and we will report the result in the near future.

The largest problem for the current system is that the author of this system initially must write VBScript programs for Active Server Pages and JavaScript programs for Multi-media integration. In order to remove this requirement for programming, we are planning to develop an authoring support system.

6 Acknowledgement

The authors would like to thank Hiroshi MARUOKA at Kyushu Institute of Technology for his help in developing our German language learning system.

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Collaboration, Facilities, Initiatives and Support: Maximizing Language Learning Using the Web

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Abstract: The University of California at Davis has a strong commitment to the research and teaching of languages, with a large and diverse language department. This commitment extends deeply into using new and innovative technologies. To accomplish the mission of maximizing language learning, the new Language Learning Center was created. This paper discusses elements of our work-in-progress which addresses our mission such as: adapting facilities and providing for courseware material development and support in order to meet the needs of a campus which has made a strong commitment to technology and use of the web; redesigning existing facilities and support structures for technology uses so that a centralized system can be established; facilitating initiatives of collaboration and development, thus increasing the sharing of pertinent information; and structuring support for faculty and student language endeavors regarding the web.

Introduction:

The University of California at Davis has a strong commitment to the research and teaching of languages, with a large and diverse language department. This commitment extends deeply into using new and innovative technologies. To accomplish the mission of maximizing language learning, the new Language Learning Center was created. This paper discusses elements of our work-in-progress which addresses our mission such as: adapting facilities and providing for courseware material development and support in order to meet the needs of a campus which has made a strong commitment to technology and use of the web; redesigning existing facilities and support structures for technology uses so that a centralized system can be established; facilitating initiatives of collaboration and development, thus increasing the sharing of pertinent information; and structuring support for faculty and student language endeavors regarding the web.

Objectives:

The objectives for maximizing language learning using the web are as follows:
1. Providing information on collaboration and relevant technology/pedagogy trends, including templates.
2. Upgrading and modernizing facilities and equipment to address Language Learning Center needs.
3. Providing development opportunities for faculty, staff, and students via workshops or personal support.
4. Increasing the quality of work on intra- and internet/web activities and classroom activities.
5. Extending the contact hours for students so language education may continue via the web after class.
6. Supporting internet and intranet initiatives and organizing resources in a meaningful, efficient way.

Collaboration:

A key element in making technology work and reducing the stress and fatigue of users and developers is an initiative involving collaboration. Rather than re-inventing the wheel, providing an environment of information and collaboration can be the greatest asset. Sharing materials within institutions and professional organizations may focus on re-purposing materials or using them as templates for the creation of other items. This may be an interdisciplinary or intradisciplinary endeavor. Aside from interdisciplinary collaboration,

within the area of language teaching at UCDavis, faculty have begun collaborative efforts regarding the development of rather generic language multi-media web or intranet templates for department-wide use. Further, working with students who provide feedback on projects, as well as dedicate their time to web material development, has proven a great asset. We have found that by sharing our work, we allow for time and resources to more effectively improve language learning with technology.

Facilities:

Rather than use traditional audio-lingual language learning consoles, the main goal now is to utilize the web not only for its resources but its potential to afford faculty and students the ability to reap the benefits it has made available to education. Courses will be using digitized video, audio, and text in a wide variety of means and formats on the intra- and internet as part of the teaching and learning process. In an effort to address this, the facilities have drastically changed. What was formerly a cassette-based lab is now in the process of becoming a digital computer lab with full access to the web. This includes a classroom lab, an open lab, a video lab, a developer's editing suite, and other resources for faculty and student use. Transforming traditional rooms, part of maximizing web use certainly does include reworking the "standard" equipment for language studies and incorporating new technologies.

Initiatives:

UCDavis has developed a variety of technology/web initiatives. One of the greatest inter-disciplinary collaborative endeavors for using the web is the R.T.A. (Remote Technical Assistance) program. R.T.A.provides a seamless mechanism for on-line interaction between students and instructors using the internet as the communication medium. This includes enhanced messaging where students can send requests for assistance, attach a screen snapshot, attach a file containing word, image or voice material pertinent to a course topic or assignment, and annotate or return messages. Further synchronous interaction is included where students and instructors can engage in real-time two-way or group discussions involving multilingual text dialogues, attachment of replayable sound messages or other files, "whiteboarding" using shared images brought up by any participant, Netscape sessions, or testing. This is an ongoing project in the Language Learning, involving languages, Computer Science, and the Instructional Technology Departments.

Another initiative is a Chinese character web-based project creating using animated gifs. These materials instruct students on drawing the Chinese characters, specifically order, direction, and placement. This coordinated effort focuses on dividing the development and creation of materials, while fostering collaboration, thus reducing the amount of redundancy of materials on the web and allowing for better production of materials.

A variety of easily-adapted Authorware templates have been developed for language studies. These materials may be "shocked" and placed on the web so that students can access them off-campus at any time for practice and tutoring, incorporating audio lingual, multi-media, and text-based activities.

Further, various courses have developed webpages which function to incorporate cultural realia and elements from the internet which really enhance student learning in classes. A series of templates has been created so that faculty can easily adapt and create their materials.

Course folders and listserves for classes is another important aspect of using the intranet in language learning. Maintaining an account for a class on the server which allows for the instructor and students to interchange materials has provided a fantastic forum, in addition to the course listserves, for students to exchange ideas and discuss topics.

Support:

To efficiently use technology, effective support must be in place. Support staff hiring, skill development, and administration are key issues in developing a language learning center and maximizing its effectiveness on campus. The development of web materials for coursework must be supported with technical

staff, resources, and training. Some of the greatest pitfalls for instructors creating web materials is the learning curve, time costs, and lack of recognition. A key approach to dealing with these difficulties is by providing trained student assistance, recognition via institutional newsletters/journals or outside presentations, and adequate facilities. Particularly with the web, language students and instructors both need to evaluate the resources they use in class and resources they create, assessing their validity and pedagogical soundness. Further, resources available from various professional organizations provide a great deal of documentation and information. This strong technical support mechanism increases the educational impact and value of language learning using the web.

Conclusions:

Defining these elements of language lab maximizing is a work-in-progress and will eventually result in an analysis of organizing an effort to unify web technology endeavors for language learning. This also encompasses the design of a systematic set of initiatives for dealing with facilities, collaboration, information, and users in such a high-tech, dynamic environment.

Communication and Collaboration of Teachers through Networking and Digital Portfolios

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In future children and teachers will work together to construct knowledge in collaborative networks both locally and globally. Networking, facilitated by information technology, can help create a culture that encourages and supports schools in ongoing development. Networking is essential in the improvement of both teacher expertise and student learning. And it will extend the possibility for continuous and speedy on-line sharing and assessment of information concerning school level development work. And again, a good assessment system allows children and teachers to construct a shared understanding of the quality of daily life in educational settings.

Background of the study

This study is a third cycle in the action research project "Flexible learning in early childhood environments". In the first cycle portfolio assessment was developed as an ecological research method in close co-operation with one kindergarten and school. The aim was to attain children's ideas of their meaningful learning experiences. In the next cycle the national network of collaborating kindergartens and schools was established. The main aim was to make visible and evaluate the development work by the means of project portfolios. Participating kindergartens and schools were enthusiastic in constructing their own portfolios. They also assessed the portfolios of other projects in the network and got new ideas for their own work. However, there was still a lack of direct communication between these local projects, between groups of teachers and children in different parts of Finland. Thus, in the third cycle of the action research project, the emphasis is on direct, technology-enriched communication and collaboration of teachers and children.

Ecological framework

In this study the actual participants act as a source of information in describing their experiences in and observations of the learning environments. For this kind of research, which seeks the point of view of the participant in the technology-intensive learning environment, Salomon (1996) suggests an ecological approach and systemic thinking as a theoretical frame. In an ecological approach the individual (child or teacher) is seen in context, thus the attention is focused on the learner and his/her various learning environments. This holistic perspective particularly highlights the reciprocal relationships of the learner and different surrounding environments. In addition to providing a framework for the development of different educational methods or the design of different learning environments, an ecological approach is used in the analysis and assessment of these learning environments. In these analyses and assessments the focus is on the interaction of the whole learning context and the individuals within it. (e.g. Haney & Cavallaro 1996; Salomon 1996.)

Network of teachers and children

When using the actual participants as a source of information in diverse educational settings, there will be challenges for the methods of data collection. One of the central questions is, how to establish such methods

through which we can hear the experiences of the children or teachers, make visible their points of view and which adequately describe the diversity of learning in different environments. In order to evaluate different approaches of open childhood learning environments, a research and communication network was established. Participants in the technology-based network are teachers and children in collaborative projects or teams in 10 kindergartens and 5 primary schools in different areas of Central Finland. The use of information technology (e.g. electronic mail, digital portfolios) will extend possibilities for continual and rapid transmission of information concerning local development work and also for interactive discussion, feedback and authentic assessment of projects inside the whole network. Teachers are also encouraged to participate in the professional discussions both in national and international computer networks and discussion groups.

Digital portfolios

The development work is made visible, followed and assessed through the research network by means of web-based digital portfolios. One of the main advantage of digital portfolios over more traditional ones is that they can present a more complete, richer and real-life picture of the school, teachers and students through the multimedia elements of the documents and continuous self-reflection. At its best the digital school portfolio includes various perspectives (e.g. teachers, children's, parents) on school-life. These perspectives can be shared and combined by the means of information technology. Digital format of portfolios makes it also possible to communicate essential information from one kindergarten or school to wider audiences across distances, because the web-based portfolios can be accessed from any networked computer. And vivid and continuous communication between teachers, children, and interested others will strengthen their collaboration and make possible the development of new educational cultures and learning environments. (e.g. Barrett 1994: Niguidula 1996). In this project digital portfolios are used interactively as a means of open research work; portfolios are presented, discussed and assessed in the digital network of teachers and children. The computer environment provides a level of complexity for the information representative of the actual setting, the tasks and activities the participants are engaged in. These are consistent with the authentic activities of different projects, and the tasks are meaningful to the participants' own development and research interests.

In the beginning of the project the central focus has been on the ongoing support of teachers. In the school years 1998 - 1999 the emphasis is both on the construction and assessment of the digital portfolios and on the experimentation, use, and evaluation of the communicative network. Large amounts of interactive information from the kindergartens and schools in the computer network require elaboration of new kinds of information sharing and analyzing methods. The great challenge for the development of methods of analysis is the multimedia format of the data. The most central methodological concern in this study is the development of quality criteria for the assessment of digital portfolios in collaboration with the participating kindergartens and schools.

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A History Visualization for Learning-by-Exploration in Hypermedia on WWW

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Abstract: Educational hypermedia provide learners with hyperspace where they can explore with a learning purpose in a self-directed and constructive way. As the exploration progresses, however, what and why they explored so far often become unclear. They cannot finally find what to explore next. In order to resolve this situation, it is necessary to reflect on to what extent they learned and what is insufficient for achieving a learning purpose. This also requires them to think back to their history and to reorganize the contents they explored. In the context of exploring educational hypermedia provided on WWW, this paper presents a history visualization which helps learners reorganize the explored contents to find what they should visit next. This paper also describes a history visualization tool called *HiVis*, and its preliminary evaluation. The results indicate that the history visualization is informative for learners.

1. Introduction

In the last few years, there have been increasingly provided various types of hypermedia on WWW, which are designed from an educational point of view, or which are worth learning. Learning with such educational hypermedia has become more and more important [Brusilovsky 1997].

Educational hypermedia generally provide hyperspace where learners can explore in a self-directed, self-regulated, and constructive way [Kashihara et al. 1997]. In exploring with a learning purpose, however, what and why the learners explored so far often become unclear as the exploration progresses. They can not finally find what to explore next for achieving the learning purpose. This is a well-known problem in hypermedia called "*get lost in hyperspace*" problem [Nielsen 1990; Conklin 1988].

Current work on hypermedia systems provides several navigational aids [Brusilovsky 1996], which present users with the candidates they should explore next. These aids can help learners who know what to explore next, and who do not know where it is. However, the navigational aids are not so fruitful for learners who do not know what to explore next since they cannot understand why they should follow one of the candidates. In order to resolve the "*get lost in hyperspace*" situation, it is indispensable to reflect on to what extent the learners learned and what is insufficient for achieving a learning purpose. This also needs to think back to their history in the hyperspace to reorganize the contents they explored.

In current hypermedia systems, an exploration history is often visualized so that learners can pay attention to it. However, it is done in a straightforward way. More informative visualization requires greater consideration of what to and how to visualize in regard to learners' history, which is the main issue addressed in this paper.

In the context of exploring hypermedia on WWW with one learning purpose, this paper proposes a history visualization, and presents a history visualization tool called *HiVis* (History Visualization). *HiVis* monitors the learners' exploration activities to make history, which includes the hypermedia nodes (WWW documents) and links they visited. The history is visualized on their demand so that the learners' exploration cannot be restricted as much as possible. *HiVis* provides three types of visualization which are not currently implemented in standard WWW browsers such as Netscape Navigator or Microsoft Internet Explorer. This paper also describes a

preliminary evaluation of *HiVis* with four subjects. The results indicate that the history visualization is informative for learners.

2. Learning-by-Exploration

2.1 "*Get Lost in Hyperspace*" Problem

Educational hypermedia provide learners with a hyperspace where they can explore in a self-directed and self-regulated way. In the hyperspace, learners can learn the hypermedia material with a learning purpose in a constructive way. As the work on cognitive science pointed out, the mental efforts involved in the exploration contributes to enhancing learning [Carroll et al. 1985]. However, the constructive learning by exploration is not so easy [Kashihara et al. 1997]. As the exploration progresses, what and why learners explored so far often become unclear. At last, the learners cannot find what to explore next for achieving the learning purpose. This is called a "*get lost in hyperspace*" problem.

2.2 Learning Support

Resolving the "*get lost in hyperspace*" problem requires learners to reflect on to what extent they learned so far. This also requires them to reorganize the contents they explored. One approach to this problem is to present the learners with the candidates to be explored next [Brusilovsky 1996]. This allows them to focus on reorganizing the explored contents. However, such a navigational aid would not work effectively unless the learners have their consciousness of reorganizing what they explored. In addition, it reduces the opportunities for them to explore other places in the hyperspace, reducing mental efforts to be involved in the exploration and the intrinsic effectiveness of learning-by-exploration [Zeiliger et al. 1997; Kashihara et al. 1997].

The other approach is to give learners some support on their demand so that exploration activities cannot be restricted as much as possible [Zeiliger et al. 1997]. This means to encourage the learners to make suitable mental efforts in exploring [Carroll et al. 1985; Kashihara, Hirashima, and Toyoda 1995]. Following this approach, we propose a history visualization which helps learners reorganize their exploration history, and find what to explore next in hyperspace. The history visualization should fulfill the following requirements.

Reorganizing history first requires learners to reproduce the thought processes during their exploration in hyperspace. It also requires them to rethink the history from several viewpoints. Second, finding what to explore next requires learners to recognize to what extent they accomplished a learning purpose. The history should be accordingly visualized so that such reproduction, rethinking, and recognition can be facilitated.

2.3 Related Work

Current work on hypermedia systems has provided a number of exploration aids. The representative aid related to history visualization is graphical overview diagrams. Graphical overview diagrams display hypermedia nodes and links [Domel 1994; Mukherjea and Foley 1995]. They can be also views of already visited subspace. They are generally generated and displayed before learners start exploring. The diagrams allow learners to directly access the hypermedia nodes by clicking on the corresponding nodes in the diagrams. These diagrams can inform the learners where they are, where they have already visited, and where they have not visited. However, there are some problems as follows.

The original network structures that hypermedia have are usually very complicated. They are accordingly filtered so that they can be understandable for learners. The filtered network structures result in overview diagrams [Mukherjea, Foley, and Hudson 1995]. Exploring with such diagrams is more restricted compared to exploring the

original hypermedia. In addition, overview diagram generators on WWW usually attach URLs of WWW documents or title tags in the HTML files to nodes in overview diagrams [Mukherjea and Foley 1995; Domel 1994]. Learners may consequently have difficulty in recalling the contents of the visited nodes.

3. *HiVis*

In this section, we discuss what kinds of history visualization are necessary, and demonstrate *HiVis*.

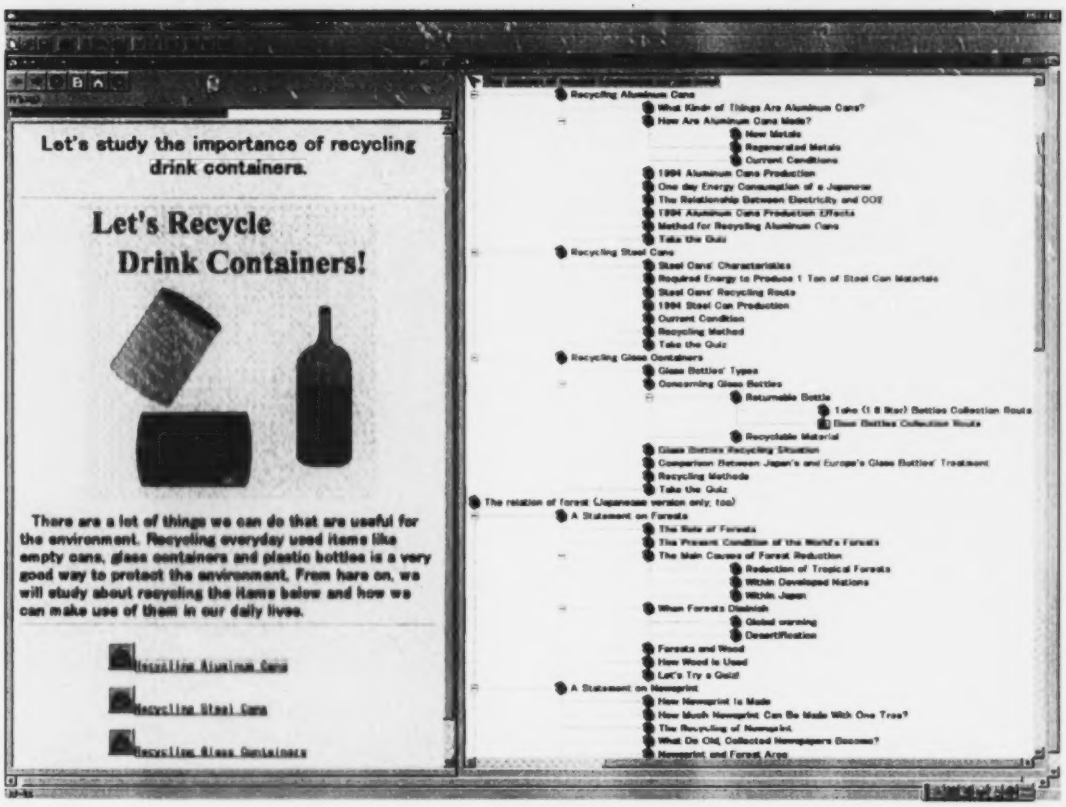
Let's study the importance of recycling drink containers.
Let's Recycle Drink Containers!
There are a lot of things we can do that are useful for the environment. Recycling everyday used items like empty cans, glass containers and plastic bottles is a very good way to protect the environment. From here on, we will study about recycling the items below and how we can make use of them in our daily lives.

Figure 1: Interface of *HiVis*

3.1 Interface

Before discussing the history visualization, let us present the user interface of *HiVis* in Figure 1. In Figure 1, a learner visits the homepage of hypermedia material "Recycling of drink containers." Exploring WWW documents with one learning purpose in the left window, the learner can look at his/her history in the right window when necessary. The interface monitors the nodes (WWW documents) and links he/she explored to make a history including the contextual information.

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3.2 History Visualization

3.2.1 Time Sequential representation

In order to encourage learners to reproduce the thought processes during their exploration, *HiVis* visualizes the contextual information of what, how long, and why they visited so far.

As shown in Figure 2, *HiVis* sequences the nodes in order of time a learner visited. Each node is labeled the descriptor of the anchor he/she selected for exploring it in the previous nodes. During exploring the hypermedia, the learner is requested to describe the reason why he/she visits the next node whenever he/she pushes the anchor. Some examples of the reasons are (1) to go back to the previous node, (2) to look at the detailed explanation, (3) to receive an answer to question, (4) to look into related items, etc. *HiVis* tags the reasons between nodes in the time sequential representation as shown in Figure 2. *HiVis* also displays how long the learner visited each node. This may allow him/her to confirm which node is more important according to the length of time they visited.

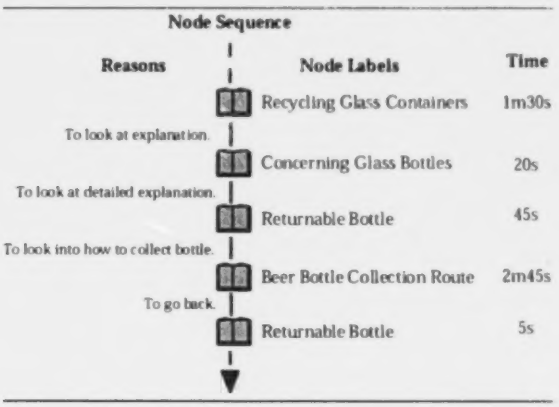

Figure 2: A Time Sequential Representation

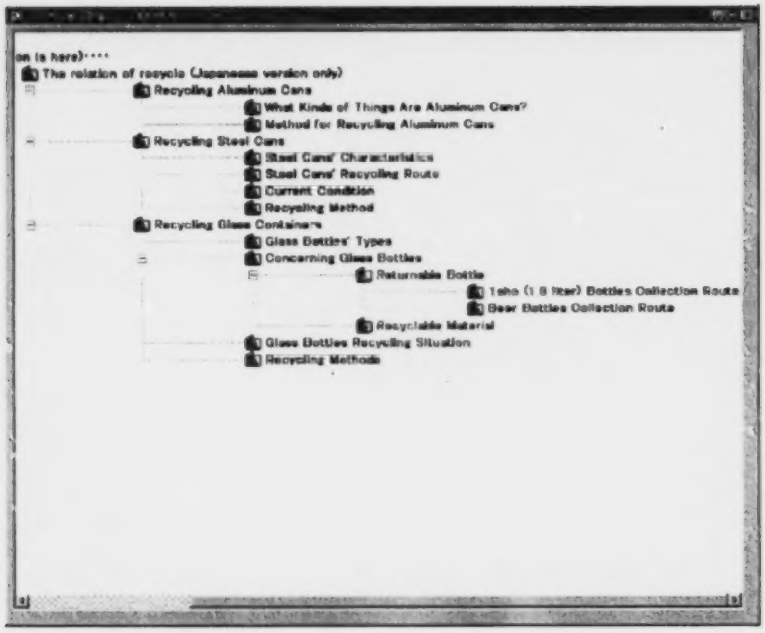

Figure 3: A Structural Representation

Clicking on one node in the time sequential representation, he/she can review the corresponding hypermedia node in case he/she cannot recall the contents of the node.

3.2.2 Structural representation

In order to give learners another viewpoint of thinking back to their history, *HiVis* superposes the history on an overview tree diagram described in 3.2.3 to display the sub-tree which comprises all visited nodes. This sub-tree allows the learners to find the structural relationships between any visited nodes, which they tend to overlook during exploring. The sub-tree may also stimulate them to group some visited nodes and their contents according to the structural relationships.

Figure 3 shows a sub-tree representation of history in which a learner explored "Recycling of drink containers." He/she can focus on reorganizing the visited contents from a structural point of view.

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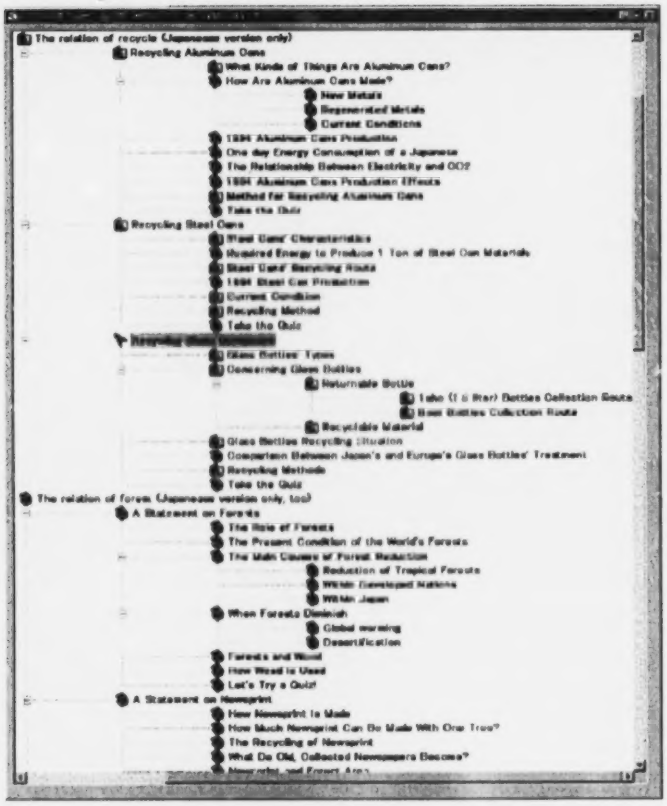

Figure 4: A Superposition Representation

3.2.3 Superposition on Overview Diagram

It is not so easy for learners to know to what extent they learned so far for achieving a learning purpose. Assuming that hypermedia material includes information necessary for the purpose achievement, *HiVis* accordingly superposes their history on an overview diagram, and visualizes the subspace they have visited and the subspace they have not visited.

The overview diagram is represented as tree. Although the root is usually the homepage of hypermedia material, learners can choose any WWW document as the root. The tree is generated from the root. *HiVis* regards nodes to which the anchors included in the root point as the child nodes. The descriptors of the anchors are attached on the child nodes. However, the anchors linking to the different servers or the ones going back to the parent nodes are omitted. *HiVis* continues finding child nodes until there are no anchors in the parent nodes.

Figure 4 shows a superposition representation with the history represented in Figure 3. The nodes learners have not visited are represented with a book icon which is closed; the nodes they visited, a book icon which is open. If an overview tree diagram is too large, *HiVis* visualizes only the neighborhood of visited nodes.

3.3 Preliminary Evaluation

We had a preliminary evaluation of *HiVis* with four subjects who were graduate students. The subjects were asked to explore "Recycling of drink containers" with a learning purpose that is to find the differences in recycling each drink container. After exploring for a while, they were then asked to use the history visualization facility. After that, they were asked whether the history visualization is informative, and what information they got from it. The results were as follows.

Each visualization was informative as expected for all subjects. It also gave them the expected information. In addition, we got an opinion that one subject could understand why he/she did not explore nodes from the superposition representation. This means the visual representation provides the information necessary for selecting what to explore next. Some subjects also had opinions that they could not find the order of nodes they explored in the structural representation and in the superposition representation. However, these are not negative for the history visualization since the subjects should look at the time sequential representation of the history. In this case, it seems they did not well know how to properly use three types of the history visualization.

4. Conclusions

In this paper, we have presented a history visualization for learners to resolve "*get lost in hyperspace*" situation in which they do not know what to explore next. This paper has also demonstrated *HiVis* which provides learners with three types of history visualization: time sequential representation with contextual information, structural representation, and superposition representation. The time sequential and structural representations stimulate learners to reorganize the contents they visited so far; the superposition representation, to choose what to explore next. The learners are expected to use these visual representations properly.

We also had a preliminary evaluation of *HiVis*. As a result, the history visualization was informative. In the future, we should have more detailed evaluation to make problems clearer, refining the history visualization provided by *HiVis*.

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The Virtual Reference Desk: Supporting Education Through a Network of Human Expertise

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Abstract: Digital reference, or "AskA," services connect students, educators and other K-12 community members with experts in subject areas and information referral. The Virtual Reference Desk Project was created to ensure that all questions of the K-12 community are addressed by appropriate experts and that all AskA services have the necessary resources and support to manage their question and answer processes effectively and efficiently. The Project is sponsored by the ERIC Clearinghouse on Information and Technology and the National Library of Education, with support from the White House Office of Science and Technology Policy. This paper discusses the value of AskA services in K-12 education and the objectives and activities of the Virtual Reference Desk Project.

1. Introduction

Students, educators, and parents are turning to the Internet for assistance with questions. Instead of relying on the Internet's collection of static information, K-12 community members connect to people who can provide the necessary guidance and expertise on topics such as Alaska, causes of acid rain, and lesson plans on colonial America. Digital reference, or AskA, services respond to such questions by providing information referral and subject expertise. Their popularity has boomed over the past few years causing many services to fall behind in responses to questions and to leave many information needs unmet. With increased connectivity to the Internet in K-12 schools, the volume of questions to AskA services is expected to increase [Lankes, 1997].

In order to accommodate this growth, the Virtual Reference Desk Project is building a set of tools and resources to facilitate the question-answer process and support the efforts of AskA services. The Project is sponsored by the National Library of Education and the ERIC Clearinghouse on Information & Technology, with support from the White House Office of Science and Technology Policy. Its aim is to ensure that all Internet-bound questions of the K-12 community are addressed with appropriate expertise and that those who wish to provide expert assistance have the necessary resources and training. This paper illustrates the importance of digital reference service in K-12 education and presents goals and resources of the Virtual Reference Desk Project.

2. Digital Reference and K-12 Education

AskA services support learning and teaching in many ways. Information specialists (or experts) from AskA services can motivate students to learn by providing quick access to current and relevant subject information and by offering positive feedback in the form of personal messages [Harasim et al., 1995]. AskA services can help teachers plan instruction by directing them to sample lesson plans and by sharing their own experiences in areas such as technology in the classroom. By utilizing AskA service expertise, the K-12 community can extend its information base as well as its instructional support system.

2.1 Functions of AskA Services

Current AskA services offer two main types of expertise—subject matter (providing mostly factual information) and information-referral (providing mostly pointers to information resources). Specific services are geared towards different audiences within and beyond the K-12 community.

Online experts and traditional reference librarians play similar roles. While reference librarians speak to patrons from across the reference desk, experts of AskA services respond to user inquiries via the Internet. Although some experts go beyond the role of the librarian by providing subject expertise, they participate in the same process of connecting users to information sources (human or otherwise) to fulfill information needs. In addition, experts can play an instructive role in promoting subject skills and general information problem solving skills. For instance, they can demonstrate the paths taken to find particular information sources, explain why a certain answer is correct, and provide additional practice questions or ideas to promote reinforcement.

3. Virtual Reference Desk

The Virtual Reference Desk seeks to identify and provide the resources necessary to link all K-12 community members to appropriate expertise in order to satisfy information needs and support teaching and learning. Activities in the first year of the Virtual Reference Desk Project consisted of research, relationship-building and resource creation to accomplish the following objectives:

- *Research the Current State of K-12 Digital Reference Service* - The Virtual Reference Desk team has conducted research on existing services to identify subject areas currently addressed, processes and tools used in service operation, and ways to capture and reuse knowledge generated by services (i.e., collections of previously-answered questions). Six exemplary digital reference services were studied to identify common characteristics [Lankes 1998].
- *Provide a Central Point of Access* - The Project is developing a central Web site for capturing and distributing incoming K-12 education-related questions; storing existing questions, answers and user information; and providing support to AskA services and experts. The Virtual Reference Desk is working with a consortium of representatives from areas of technology, digital reference, library science, business, and education to help guide the creation of these resources and the overall Project.
- *Facilitate the Efforts of AskA Services* - The Virtual Reference Desk supports the efforts of existing AskA services and encourages the creation of new services to fill gaps in subject areas not yet represented. Resources and services from the Virtual Reference Desk will guide organizations through the challenging process of building and maintaining AskA services. Instructional resources (e.g., training materials, quality criteria, etc.) and support mechanisms (e.g., software, human resources, etc.) are currently in development.

Conclusion

The Virtual Reference Desk presents a real solution for connecting the K-12 community to human expertise. By going beyond the notion of the Internet as a collection of text-based resources, the Virtual Reference Desk can link students, educators, and parents to astronauts, mathematicians, virtual librarians, parenting experts, and others interested in providing information and assistance. By helping to build new, more efficient AskA services, the Virtual Reference Desk can offer the K-12 community increased support for teaching and learning.

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Focus Discipline Research and the Internet: Keys to Academic Literacy for At-Risk College Students

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Abstract: This paper describes a developmental English course that teaches reading, writing, and research skills using the Internet as a resource for sustained and focused content area study. The activities in this course are designed to provide these at-risk students with a microcosm of the mainstream college experience. Students build reading skill and become familiar with academic discourse through their interactions with electronic texts representing a variety of mainstream disciplines. Each student chooses one of these content areas as a focus discipline and pursues in depth study of that focus discipline over the course of the semester, articulating knowledge through a series of three progressive written reports and a research project.

1. Background

Academic literacy, which encompasses ways of knowing particular content and refers to strategies for understanding, discussing, organizing, and producing texts [Johns 1997], is key to success in college. To be literate in an academic sense, one should be able to understand and to articulate conceptual relationships within, between, and among disciplines. Academic literacy also encompasses critical literacy, that is, the ability to evaluate the credibility and validity of informational sources. In a practical sense, when a student is academically literate, s/he should be able to read and understand interdisciplinary texts, to articulate comprehension through expository written pieces, and to further knowledge through sustained and focused research.

Developing academic literacy is especially difficult for the at-risk student population, which includes both non-native and native English speakers who are struggling to acquire and improve the language and critical thinking skills they need to become full members of the college mainstream community. The needs of these at-risk college students may be met through the creation of a functional language learning environment that engages them in meaningful and authentic language processing through planned, purposeful, and academically-based activities, teaching them how to extract, question, and evaluate the central points and methodology of a range of material, and construct responses using the conventions of academic/expository writing [Pally 1997]. Effective academic writing requires that the student be able to choose appropriate patterns of discourse, which in turn involves knowing sociolinguistic conventions relating to audience and purpose. These skills, acquired through students' attempts to process and produce texts, can be refined over time by having students complete a range of assignments of progressive complexity which derive from the sustained and focused study of one or more academic disciplines.

Sustained content area study is more effectively carried out when an extensive body of instructional and informational resources, such as is found on the Internet, is available. Through its extensive collection of reading materials and numerous contexts for meaningful written communication and analysis of issues, the Internet creates a highly motivating learning environment that encourages at-risk college students to interact with language in new and varied ways. Used as a resource for focus discipline research, the Internet is highly effective in helping these students develop and refine the academic literacy so necessary for a successful college experience.

Used as a tool for sustained content study, the Internet is a powerful resource that offers easier, wider, and more rapid access to interdisciplinary information than do traditional libraries. Using the Internet allows at-risk college students to control the direction of their reading and research, teaches them to think creatively, and increases motivation for learning as students work individually and collaboratively to gather focus discipline information. By allowing easy access to cross-referenced documents and screens, Internet hypertext encourages students to read widely on interdisciplinary topics. This type of reading presents

cognitively demanding language, a wide range of linguistic forms, and enables at-risk students to build a wider range of schemata and a broader base of knowledge, which may help them grasp future texts. Additionally, hypermedia provides the benefit of immediate visual reinforcement through pictures and/or slideshows, facilitating comprehension of the often-abstract concepts presented in academic readings.

Academic research skills are often underdeveloped in the at-risk student population making research reports especially frightening and enormously challenging. The research skills students need to complete focus discipline projects are the same skills they need to succeed in college courses. Instruction that targets the development of research skills teaches at-risk students the rhetorical conventions of term papers, which subsequently leads to better writing and hence improved performance in college courses [Mustafa 1995]. Moreover, the research skills acquired through sustained content study and focus discipline research enable students to manage information more effectively, which serves them throughout their college years and into the workforce.

2. Course Description

Focus discipline research may be carried out in any subject area, from the humanities to the social and physical sciences, and activities are described in detail at *http://members.aol.com/Drlfk/index.html*. To illustrate the instructional approach, I will outline a unit on business, a major field of study for many students. In this unit, students are introduced to a number of business concepts, among them product development, consumer behavior, marketing utilities, and market targeting. After reading two print texts and responding to comprehension questions, students search the Internet to find information on advertising. To guide their initial Internet search, students answer questions based upon information presented on a web site on advertising (*http://www.disclosure.com/marketing/tricksadv.html*). The Internet search engages students in linguistic tasks (reading, vocabulary development, and interpretation of language structures) and in research tasks (searching for, accessing, and evaluating information).

While the entire class studies business as part of the course, students who choose business as a focus discipline continue to research this subject area throughout the semester, reporting on their research in 3 progressive short papers (2-3 pages) and in a longer research project (5-7 pages). Students who choose business as a focus discipline use the Internet to gather information on the following topics: (1) Psychological factors involved in advertising, (2) Television infomercials, and (3) Internet commerce. In the first paper, students discuss how advertisers use the basic determinants of consumer behavior in designing product advertisements; in the second paper, they explain the effectiveness of infomercials; and in the third paper, they explain how the Internet has changed the field of sales and marketing, describing the advantages/disadvantages of selling/buying products over the Internet. As students conduct Internet research, they actively practice searching for, sorting through, and organizing related pieces of information. The written projects encourage them to think critically about information while introducing them to rhetorical conventions common to business and building their linguistic and discipline-specific knowledge in preparation for a longer research report. This research report asks them to use Internet sources to prepare a historical analysis of advertising, beginning with the early 1900's and focusing on how developing technologies have changed advertising.

This course has proven very successful in raising course pass rates (to 92%), thereby enabling students to exit the developmental English sequence and become full members of the college mainstream more quickly. Students find the Internet adds a motivating and valuable component to the course. Overall, student feedback on the course has been quite positive, with students noting improved confidence in their ability to interact critically and analytically with academic material.

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Environment for Building, Developing and Viewing Multimedia Courseware in Web

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Abstract: Approach to creation and using courseware for educational process developed in Multimedia Center of Novosibirsk State University is presented. The approach is based on the collective data banks of learning materials published in the Web. Realization of the banks of learning materials as the database on SQL-server in combination with WEB client gives the basis for the platform-independence of the courseware. Data model of learning material banks and structure of developed software is described. Courseware Web Museum "Ancient Siberian Art" created in the frame of the presented approach, its usage and perspectives are discussed.

1. Courseware Production Issues

Modern multimedia technology is a good basis for creating the courseware in many fields of humanitarian and scientific character, which need a large amount of various authentic materials in the texts, pictures, charts, etc. However, great efforts in time and labor are needed for creating such a courseware.

Multimedia Center of the Novosibirsk State University encountered the problem of creating of such courseware for various disciplines. For solving this problem we had to create the method of projecting, designing, supporting and using the courseware in the frame of educational process. The preliminary analysis of the requirements of the users has revealed a number of conditions necessary for successive activity. First, there are some teachers getting ready to work on the subjective-contentive part of the courseware but they are lack of time for creating the complete course as itself. Second, the unanimous requirements both of the teachers and students to such sort of projects are as follows: the whole bulk of software should not demand any new knowledge either at the stage of installation or supporting and using. Third, this courseware should be continuously developed and modified during all period of functioning. As the time of life of such a course is much more than the time of moral obsolescence of computer systems it means that the courseware must not depend upon computer platforms and operation systems.

The concept of our approach is based on the following: the teachers make the courseware on the base of collective data banks of learning materials. Thus, it is possible to organize the multiple use of learning materials and so to decrease the efforts for development of the courseware. So, the concept determines the net character of the courseware. Using Web browser as a client software allows to get rid of non-standard computer-client software. Implementing the banks of learning materials as the database on SQL-server in combination with WEB client gives the basis for the platform-independence of the courseware. Only the intermediate layer of software fulfilling the data transmission between the client and the banks of learning materials depends on a concrete operation system at the recent time. However, this part of software can be easily modified for any other platform or made on JAVA.

2. Structure of Software for Courseware Environment

The databanks of the learning materials is made in the relational database model. The user works within the special terms of these data banks. The main ideas are the objects and their classes. All classes and objects are divided into the types of "elements", "catalogues" and "lists". All the objects of the banks of the learning materials have common fields as well as common numeration in the database by which the access to the objects is organized. The objects "elements" (i.e. resulted from one of the classes of the type "element") has common data fields storing in the separate table related to the given class and common rules of editing and viewing keeping in special templates which are also related to the class. The mechanism of the classes allows organizing

plenty of objects with similar behavior as well as to search and sort. At the same time the mechanism of classes simplifies the procedure of creating and editing of the objects bringing them to filling the fields of common template. The objects of the classes "catalogue" are of additional functionality that allows organizing the hierarchical structure as the rooted trees where the leaves are the "elements " and the knots are the "catalogues". Such structures are the essential part of the learning material banks implementing the function classification and cataloguing of homogeneous materials. Objects "lists" link the elements, which play the role of the pages into the lectures.

All classes of the objects can include the special fields allowing hyperlinks of two types. The first type is hypertext reference, which corresponds to standard hypertext reference. The second type is hypertext insert, which allows including a part of one of the objects e.g. graphical image or text into the viewing of another object. Hypertext inserts allow creating the lectures, which give all the necessary information on their frames without extra navigation in hyperspace. The work on the level of transactions with the classes and objects is being done by the intermediate program level, which is realized as the library of function and translates the transactions in SQL-query to the database.

From the side of a client the work is organized on the base of HTML which is mainly connected with the requirements of work with different browsers and operation systems. In the next software release, we are going to use JAVA applets which widen the functionality of the client.

The interaction between the client and the bank of the learning material is organized through WWW server working together with hybrid CGI-interface, consisting of CGI broker and co-process. Web-server (we used WebSite v.1.0) processes HTTP-queries and transmits them to the co-process (a special program implementing the role of courseware server). The transmission is through the broker, which allows decreasing the time of working with query due to its small size. The courseware server works in the background mode and expects the queries of the clients. The query including the commands of viewing, searching and editing of the learning materials, the commands of designing of hierarchical trees, etc, dispatches to one of the sources of the server where it is translated into the query to the data base. The obtained data are used for constructing the answer and are sent to the client through the server.

The above mentioned courseware suppose the next users and the correspondent rights to the data assess:

- administrator (assess to the organization of the new data banks);
- developer (assess for the creating and editing of the classes, customizing the templates and other functions on the creation of general structure of the courseware);
- author-teacher (assess for the creation of the editing of the objects, forming of the lectures);
- user (assess for the viewing of the learning material).

3. Web Museum "Ancient Siberian Art"

The environment of development and presentation of the courseware is used for the creation of the courseware for some subjects at the humanitarian departments of Novosibirsk University. The most developed is the project of learning Web museum "Ancient Siberian Art" on the base of which the special course "Middle-aged Art of the South Siberia" has been delivered. Web museum is based on the system of metaphors connected with the museum as with some sort of scientific institute on the collecting, keeping and presentation of scientific-technical information. The approbation of this special course helped to better evaluation of the possibilities and perspectives of Web technology and our approach to its using.

Due to the described courseware environment, the archaeologists, museum workers and teachers from various research institutes and museums of Siberia took part in the work of creation of learning materials. A large bank of learning materials on the Ancient Siberian Art has been created. More than 500 archaeological objects have been presented there. All the objects have the standard scientific description and are cataloguing in archives on eleven sections: tourevtic (artistically processed metal), petroglifs (rock pictures), ivory artistic handiwork, tattoos and others. The glossary, which included many articles on many sections (mythological, terminological dictionaries, etc.) has been comprised. The large bibliographical reference has been made. The texts of the lectures are well illustrated and suppose not only the sequenced studying of the material but also the excursions to the museum as well as the addressing to the various sections of glossary and the fulfilling the tests.

The further work on the development of Web museum is continuing on various directions. First of all it means the increasing of data bank: introduction of the new objects representing different kinds of arts and chronological periods and also working out the new courses of lectures. In this connection we have the task to

increase the number of experts – co-authors of the courseware. The development of inter-university co-operation is another task of the project.

The Web museum "Siberian Ancient Art" is free of boundaries between the countries and the continents, peoples and historical ages. We hope that getting familiar with the bright diverse original Siberian art will widen the horizons of knowledge about ancient cultures for the scientists, students and all who are concerned.

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Remote Research using the EMSL Virtual NMR Facility

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Abstract: Pacific Northwest National Laboratory's Environmental Molecular Sciences Laboratory (EMSL) is a new national user facility housing a variety of state-of-the-art nuclear magnetic resonance (NMR) spectrometers. As part of our Collaboratory for Environmental and Molecular Sciences effort and, we have developed a 'Virtual NMR Facility' that combines secure remote operation of the EMSL's NMR spectrometers with real-time videoconferencing, real time computer display sharing, a Web based Electronic Notebook, and other capabilities. Users of the Virtual Facility have secure direct acquisition control of the EMSL spectrometers and can consult with EMSL staff for training and during setup to optimize the experiment. The electronic notebook allows organization of group notes, drawings, proposed molecular structures, etc. This paper describes the general requirements for a virtual scientific facility, details the specific capabilities available through the EMSL Virtual NMR Facility, and shows how they are being used in the Facility's first project.

1. Introduction

Implementing remote control of a scientific instrument is often seen as both necessary and sufficient for enabling distributed research teams to effectively perform experiments on the instrument. In practice, many other capabilities are needed. Remote researchers need to be able to discover the existence of the instrument and learn about the process for requesting time on it. They need to be able to schedule their experiments and work with local technicians or collaborating researchers to receive training, learn local procedures, guide local sample preparation, consult on experiment setup, etc. Once the sample is in the machine, the remote researcher may wish to control the experiment directly or simply monitor progress. Once data exists, remote researchers need access to the data files and local analysis programs. Remote researchers may again wish to consult with their local counterparts during analysis or during the preparation of articles based on the work. Throughout this process, a central repository of background information, plans, ideas, progress, reports, decisions, etc. is needed to allow the team members to coordinate their actions. In summary, the development of remote capabilities for an instrument may be a small part of the overall effort required to make remote/collaborative experiments an effective alternative to travelling to a remote site and running an experiment in the traditional manner.

2. The EMSL NMR Virtual Facility

The EMSL NMR Facility houses several state-of-the-art spectrometers that, as part of the EMSL user facility, are available for use by external researchers (independently, or as part of a collaboration with EMSL researchers) on a competitive proposal basis. (See http://www.emsl.pnl.gov:2080/docs/msd/mrf_guide/). The EMSL Virtual NMR Facility (VNMRF) is designed to allow these researchers to complete their experiments more effectively by increasing their access to EMSL resources before, during, and after use of the spectrometers themselves. Perhaps the best way to describe the VNMRF is in the context of the first experiment conducted using its capabilities. This experiment, a collaboration between Jeff Pelton at Lawrence Berkeley National Laboratory (LBNL) and one of the authors (Kelly Keating, at the EMSL), is designed to elucidate the structure of Heat Shock Factor (HSF) protein molecule. (HSF is a transcription factor that enhances cellular production of heat shock proteins in response to environmental stresses.)

Initial sample preparation was done at LBNL. The collaborators, who had not met in person, used EMSL's CORE2000 real-time collaboration environment to get acquainted. CORE2000 is an extension of the National Center for Supercomputing Applications (NCSA) Habanero environment that integrates audio and videoconferencing, whiteboards, shared computer screens, chat box, and several other tools. Pelton and Keating used EMSL's electronic notebook to share literature references and sample preparation procedures prior to the NMR experiments. Other than sample preparation and the actual insertion of the sample into the spectrometer, all aspects of the experiment have been done collaboratively over the Internet. Jeff Pelton (at LBNL) is able to securely login to the EMSL 750 MHz NMR spectrometer from his office computer, run the data acquisition software, and access data files. Keating works with Pelton via CORE2000, discussing parameter settings and watching via CORE2000's dynamic screen sharing software as Pelton enters changes. (Pelton's access to the data acquisition software is via X-Windows. Secure shell (ssh, see http://www.cs.hut.fi/ssh/) is used to provide an authenticated encrypted tunnel across the Internet that protects the spectrometer from session hijacking and other hacker threats.) While Pelton controls the spectrometer directly, both participants see the NMR console display, and together make adjustments, collect trial spectra, and finally decide to start the experiment, as though they were sitting together in the laboratory. A series of complementary experiments on HSF have now been completed this way, and data analysis is proceeding, with both real-time and notebook-based exchanges occurring frequently.

3. The Process of Developing a Virtual Facility

Developing the VNMRF required considerable commitment from both the NMR researchers (Pelton and Keating) and the EMSL Collaboratory development team. The NMR researchers were asked to analyze the way they conducted experiments and identify the tasks that compose the experiment lifecycle. They were also asked to help identify which of these tasks would benefit most from close collaboration and what information needed to be shared to accomplish these tasks (data files, parameter sets, literature references, etc.) The developers worked to extend the existing tools (using programming interfaces designed for this purpose) to customize the collaboration tools for NMR. For example, the base electronic notebook was extended to display 3-D rotatable protein structures and contour plots of spectra. Links to the notebook were built within the data acquisition software to allow parameters sets to be automatically sent to the notebook. Thus, an "NMR Spectroscopists' Notebook" emerged. As the experiments proceeded, the researchers' input was used to help refine existing tools and to prioritize new developments. In many cases, simply using the electronic collaboration tools gave the researchers ideas for new ways to work together. We believe that this cooperative process - up front analysis, the deployment of extensible base collaboration tools, and iterative development, deployment, and feedback - has been critical to our success and that such an approach is necessary in adopting electronic collaboration tools because of the coupling between user expectations, scientific workflow, and collaboration technologies.

4. Conclusion

We have found the VNMRF to be an effective means for running NMR experiments with remote colleagues. With the very visible success of Pelton and Keating as motivation, more than half of the first round of EMSL NMR facility users have opted to conduct some or all of their experiments remotely. We are extending the virtual facility concept to other areas of the EMSL and anticipate that such facilities will quickly become a standard way for researchers to access expensive state-of-the-art high field instruments and to work with remote colleagues more efficiently.

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Audience Parameterization in Multimedia Authoring

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Abstract: Existing authoring systems usually adopt different approaches to authoring with ranging complexities. Much of the research today has focussed on how would the final multimedia application look leading to little, or even a lack of, concern with authors and the process of authoring itself. This work looks at the problem of authoring from the authors' point of view. The authoring process is analyzed and some guidelines, in the form of a paradigm, are produced describing its main stages and characteristics. A new authoring paradigm, starting with audience parametrization and going all the way to fine grained object instantiation is presented. Central to our approach is the way we look at how the author may adapt objects to its own subject and to its audiences. We hope that through the proposed model, we reduce efforts wasted on what we refer to as "mechanical steps", hence allowing the author to concentrate on more productive project design and thinking.

1 Introduction

Recent studies conducted by researchers from different institution lead to the use of models where the audience is considered as the main element of the system author-object-user. In his book "*Designing Visual Interfaces*" [Mullet, 1995] presents the difficulties encountered by project designers in defining the intended audience and tries to seek in the theory of communication concepts that may assist designers in gaining better understanding the parameters that should delimit their projects. This proposed technique has been known as the "*communication oriented technique*". Another alternative proposal presented by [Bonsiepe 1997] in his book "Interface, an Approach to Design" follows the same line of thinking, confirming the relevance of the theory of communication as a conceptual basis for multimedia design projects.

2 The Authoring Model

We look for a model that uses concepts from the theory of communication and takes advantage of the current technology resources that are available such as the Internet. The proposed model has been tested and evaluated with the participation of graduate students from our visual programming course since 1996. It takes as its basis, the technique described in [Dondis 1991] in order to describe the audience's graphical object repertory. This model is divided into stages representing the different tasks undertaken by authors during the development phase.

It is a distributed multimedia generic authoring model with four main modules namely presentation, authoring, hypermedia and distribution support. The authoring module is the object of detailed study in this paper. It is divided into two main parts: authoring in the large and authoring in the small. Authoring in the large is the process that starts the modeling of an application at the most abstract level possible required by the author. This specification is then continuously refined until it results in one that is as close as possible to the application being presented. The advantages for such a separation include the possibility of re-using the conceptual model in the design of other applications where different refinements and extensions could be made in order to adapt this to its new application target. This is similar to the template concept used in software engineering design.

The methodology consists of the four stages: *conceptual modeling, navigational modeling, presentation, and instantiation.* To implement the four modeling parts, the proposed paradigm defines seven stages that an author may execute sequentially or in a cyclic way. These are: Audience parameterization with semiotic registering and

differential semantic, a global database or the Internet, generating alternatives, analysis of the alternatives, definitions of object blocks, sub-blocks and relations among them, definition of a media library, definition of the flow and object synchronization of a block, and testing.

2.1 Paratemeterization

A presentation may use spectacular multimedia resources and effects and still fail simply because the elements the author chose to use are not suitable for the targeted user group. Playing with presentation parameters, the same multimedia project may be made into several presentations where each of these is targeted at a special group or audience. The parameterization phase is where the author is invited to reflect about who will be the user of the application and take this into account when modeling and internalizing the presentation. It is in our view, one of the most important phases in the authoring process and sadly one that is left out from most existing commercial authoring systems. This work is an attempt to draw the readers' attention to this limitation and suggest an authoring paradigm that incorporates it.

The way presentation parameterization has been offered by the authoring system in this paper is certainly very helpful for the authors. The resulting presentation produced under the hints given by the system is more likely to approach its audience under most cases. However, there is still a long way to go. The ideal support given by the system would be an automatic generation of, at least, a draft of the presentation, that could be modified by the author. Furthermore, an ideal authoring system should also support the production of different versions of the same presentation for different kinds (levels) of users, keeping its structure and changing the object instances accordingly. Perhaps the major problems with this approach are not implementation issues but the conception of the idea of versions itself. The presence of a wide spectrum of users may sometimes need so many changes to be made to the original application that it becomes, not a new version, but rather a completely different one. Furthermore, some applications target a given specific user community that it does not make sense to create a version for another user group (for example we do not see financial presentations being distributed to children!).

We have shown through a comparison of some of the existing paradigms that there is no overall best paradigm, but that a suitable combination of these may produce better results. Core to this paradigm are the initial stages identified earlier, namely, authoring in the small, authoring in the large, the use of contexts, the parameterization and project design phases. The proposed paradigm combines the use of icons, the time line and structured authoring.

3 Future Work

Because of the increasing Internet popularity as a global information source, we are currently investigating the development of a high level search tools capable to look for elements (images, videos, animations, sounds, texts - not only home pages) on the Web under the input of a high level query (Ex: images and sounds related to animals). The implementation uses smart agents; a widely used technology [Garzotto, Paolini, Schwable 91a].

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Usability Testing of a Web-Based Application

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Abstract: This paper describes design experiences associated with incorporating a usability focus in the development of a web-based application for use in an English as a Second Language course. It reports on user testing of application prototypes during the development lifecycle. An outline of the plan developed for including user testing throughout the development of the application prototype is given. The plan incorporates user testing techniques associated with traditional software development, as well as remote user testing that takes advantage of the Web environment provided by the Internet. This discussion is then followed with a detailed description of several usability tests conducted during one phase of the application's development.

1. Introduction

In today's market, designing a highly usable software product that can be used effectively and efficiently, and meets the needs of its intended user group, is crucial to the product's success. Design of such a product requires that careful attention be given to issues associated with the product's usability throughout its development process. Research efforts and practical experience reported within the Human-Computer Interaction (HCI) and Software Engineering (SE) communities discuss ways and provide methods to include attention to usability issues throughout software development [Carroll 1995, Dumas & Redish 1993, Nielsen 1994]. However, research and experience in the design and development of usable websites and web-based applications is still in its infancy [Shneiderman 1997].

One of the important ways to help ensure usability is through user testing. A primary purpose of such testing is to see if people can locate, understand, and use the functionality available in an application design. Observations and other feedback gained from the testing is then analyzed, and used to further the application's development.

This paper describes the inclusion of user testing and evaluation in the development of a particular web-based application prototype. An outline of the plan developed for including user testing throughout the development of the application prototype is given. This plan incorporates user testing techniques associated with traditional software development, as well as remote user testing that takes advantage of the Web environment provided by the Internet. This discussion is then followed with a detailed description of several usability tests conducted during one phase of the application's development.

2. Application Overview

The application under development is intended for use by teachers and students in an English as a Second Language (ESL) course. Its focus is on providing support for writing activities. Such activities are an important part of ESL courses, where an emphasis is placed on writing in English by students who do not speak English as their primary language.

The application targets a hardware and software platform that is typically available to students and instructors at many universities. There are two sides to the application (one for students, and one for their instructor), which are coordinated through a database located on a web server. The instructor side provides an ESL instructor with a web-based, electronic course-book. Key components of the course-book include a class roster, and a writing assignment manager that is used for such tasks as posting assignment descriptions, grading writing assignments and archiving assignments (for use as examples in future classes). The student side

provides students with a web browser interface for viewing assignment descriptions posted by their instructor, submitting assignments, viewing their graded work, and doing peer evaluations.

3. Four Phases of Prototype Development

The ESL application prototype is currently in the third phase of a four-phase development plan consisting of (1) initial exploratory work, (2) narrowing the focus to a more detailed design and testing of a particular component, (3) design and testing of a scenario prototype [Nielsen 1994], and (4) full prototype implementation.

3.1 Phase 1: Exploratory Work

The first phase of the project began in an introductory Human-Computer Interaction course as part of an HCI community project [Kilpatrick 1996] assignment. A team of three students and an ESL instructor did initial brainstorming and exploratory design work on an application specifically geared toward the instructor's needs. This work served as an initial examination of the application's requirements and feasibility of implementation. A prototype was developed, but usability tests were not conducted on it.

Another three-member HCI student design team then worked with the same ESL instructor, and used a parallel design process [Nielsen 1994] to generate additional design ideas. Individually, each student developed paper and Web-based prototypes to demonstrate their ideas. The paper prototypes were informally tested with the ESL instructor, who was asked to try various features. In addition, informal tests of the Web-based prototypes were conduced with six students who had taken at least one ESL course. The prototypes served as a springboard for discussion with the ESL instructor and her students, which helped to further explore the application's requirements.

3.2 Phase 2: Detailed Design Work

Upon completion of the initial exploratory phase, it was decided that the application would be expanded and developed into a working prototype. The three-person design team in the second phase was made up of a computer science professor and graduate student (developers) and an ESL instructor (domain expert and potential user). A high-level paper prototype of the application was generated for both the instructor side and the student side. This prototype was based on the requirements that had been generated in the first phase. Attention was then focused on the instructor's grading component, as this was a crucial part of the system and had to be well-designed from both the instructor's and students' viewpoints. In addition, the grading component was determined to be the most technically challenging part of the system (the feasibility of implementation needed to be further explored, as the system was to be implemented in the Java programming language and some details of Java were new to the designers).

During this phase, three usability tests were conducted. In the first, a paper prototype of the grading component was quickly generated and then tested with the design team's ESL instructor. Next, a less rudimentary paper prototype of the grading component was tested with ten ESL instructors. Following that, a prototype of the grading component was implemented in Java and tested by a small number of instructors and students. The Java prototype was tested alongside a paper prototype for the instructor side and a class website prototype for the student side (these two prototypes provided context within the framework of the application as a whole for grading-related activities).

3.3 Phase 3: Scenario Prototype Implementation

We are currently in the third phase of development. The Java prototype has been revised and expanded to interface directly with a model ESL website. Although the application is not fully functional, the goal has been to implement enough of the system so that important instructor and student scenarios can be tested for usability (such a prototype, fully implemented along only a few dimensions in order to test a few scenarios, is called a scenario prototype).

In this phase, we will test the following two scenarios:

- An instructor posts a writing assignment and — after students have submitted their responses electronically — downloads the student-submitted papers from a central server, grades and uploads these papers, and then sends an e-mail message informing the students that the papers are available for review on the class website.
- A student views an assignment description, submits an assignment, receives e-mail that the assignment has been graded, and goes to the class website to review his or her graded paper.

These scenarios will initially be tested with several professors in the Atlanta-area, using a lab situation where a video feed can be used to capture information for later analysis. Upon completion of this initial user testing, feedback will be used to refine the prototype.

We will then conduct both traditional and remote user testing [Kilpatrick, Krofchok & Lane 1998] with instructors and students. Technical advances in the area of desktop videoconferencing allow less intrusive testing to be conducted on site. This removes a significant geographic limitation, and allows tests to be conducted in an environment that more closely approximates the actual work environment. Currently, we have designed, implemented and conducted user testing for a remote usability lab environment [Krofchok & Kilpatrick 1998]. The environment uses off-the-shelf components and includes a protocol for setup by a non-technical test participant of the equipment and software required for the remote testing.

3.4 Phase 4: Full Implementation

The fourth phase will involve full development of the prototype so field tests can be conducted with a small number of ESL instructors and their classes. We plan to test usability through several iterations of a cycle in which an instructor posts an assignment, students respond by submitting a paper, the instructor grades and returns the papers online, and students review their graded papers. We also plan to test other features of the system, including the class roster facility and the archiving facility.

4. Example: User Tests Conducted in Phase 2

In this section, the three user tests conducted within the second phase are described to give additional detail about some of the user testing that has been done with the prototypes, along with some of the insights these tests provided. (Recall that Phase 2 involved development of the instructor's grading component.)

Development of the grading component began with an observation of an ESL instructor as she graded a number of papers by hand. She was asked to use a think-aloud protocol [Dumas & Redish 1993, Nielsen 1994], and was thus encouraged to vocalize her thought process while grading. The design team recorded such observations as grading procedures, and the types and placement of marks and comments made on the papers.

This process led to three key observations. The first of these concerned the overall grading process. The instructor used three distinct passes when grading each paper, and read through the entire paper each time. During the first pass, she made comments about the composition of the paper as related to its intended audience. During the second pass, her marks and comments focused on the style and organization of the paper. During the third pass, she targeted mechanics issues such as spelling, subject/verb agreement, and punctuation.

A second observation was that although the student's work had been graded in three distinct passes, the paper as returned to the student simply showed an undifferentiated collection of marks and comments. The instructor emphasized the pedagogical benefit to be gained by being able to return a graded paper in which the comments and marks could be differentiated and presented to the student in three phases. With her current grading process, students tended to focus most of their attention on errors made at the mechanics level, and only paid incidental attention to comments made in the equally important areas of audience and organization.

A third observation was that the instructor used a rather elaborate coding system to specifically tag mechanics errors.

Using our analysis of the observations made of the instructor grading, we quickly created a rudimentary paper prototype of the grading component. The instructor's observed three-level grading scheme was implemented in the paper prototype using what we called the photocopy method: three copies were made of each paper to be graded (one for each level). Although it was possible to view, comment, and make marks on any level at any time during the grading process, it was impossible to do so on more than one level at the same time. In addition, a small collection of nine tools was defined for use by the instructor when marking the paper.

The goal was to provide a set of tools rich enough to support the instructor's grading style, without being overwhelming.

4.1 User Testing of an Initial Paper Prototype

Usability testing with this rudimentary prototype was then conducted with the ESL instructor whose grading process had been observed. She was able to use the prototype, with various details of the system's operation controlled by the design team's graduate student. Such a scheme allowed the functionality of the system to be rapidly altered in ways that could not have been accomplished with a hard-coded, computerized prototype.

Two key lessons learned from this testing were that the instructor was able to use the three-level grading model without difficulty, and that the set of marking tools was generally sufficient for the instructor's needs.

4.2 Extended User Testing of the Modified Paper Prototype

Following this initial round of usability testing, a modified paper prototype was created, see [Fig. 1]. Although the original prototype had been specially customized for a particular ESL instructor, it was felt that the application might be useful to other ESL instructors. In order to gain further insight about this possibility, usability tests were conducted on the revised paper prototype by three-person teams in a graduate-level HCI class. Ten ESL instructors participated in the exercise. The student test teams developed scenarios for use in testing, had participants use a think-aloud protocol, videotaped testing sessions for use in later analysis, wrote a document describing key findings, and made a short videotape highlighting key usability problems encountered by participants [Dumas & Redish 1993].

Figure 1: The modified paper prototype of the instructor's grading component, showing the mechanics level.

A number of important findings were uncovered by these tests. One major finding concerned insight into the instructors' use of the various levels. Some instructors did not use all of the levels, while some made fewer reading passes as they graded. The testing revealed that more information needed to be gathered about the specifics of how ESL instructors tended to grade papers.

A second finding was that the process used to automatically save marks and comments made while grading was not clear to several users. Although this process (which involved a fairly elaborate protocol) was intended to be transparent to the user, testing revealed that it instead frequently led to confusion.

A third finding concerned the making of marks at the mechanics level. Since the instructor's process involved tagging each mark with a specific code or brief comment that indicated the exact nature of the error, a protocol was needed that allowed a mark to be tagged after it had been made. The tagging process was observed to be confusing to several users, and on later analysis was felt to be partially due to the busyness and complexity of the code choice presentation.

Other findings dealt with the wording of certain buttons, the lack of context sensitive help, and the need for more navigational cues to additionally emphasize the level at which grading was being conducted.

4.3 User Testing of the Java Implementation

After testing of the paper prototype had been completed, a computerized prototype of the grading component was implemented in Java, see [Fig. 2]. It incorporated many of the findings noted above, and also attempted to resolve additional potential usability problems that were uncovered during its implementation.

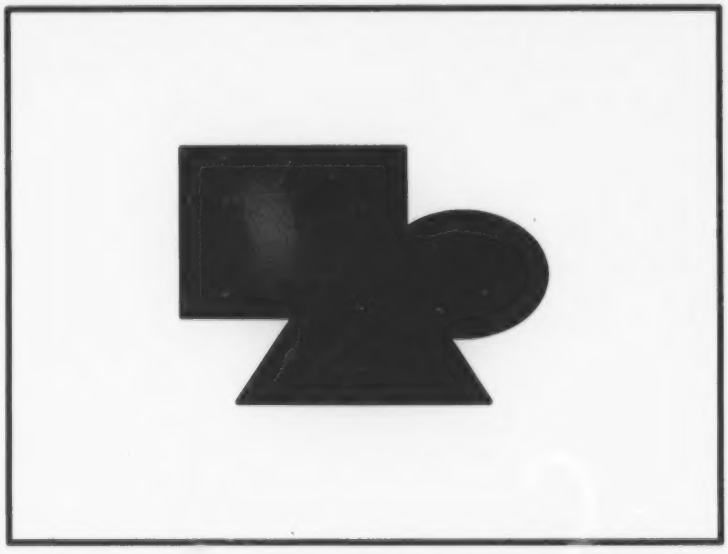

Figure 2: The Java prototype, showing a mechanics-level comment being reviewed

A third set of usability tests was conducted with this prototype. Test participants included a small group of ESL instructors and students. Instructors used a simple paper prototype of the application as a whole to gain context, then switched to the implemented component to do actual grading. Students used a class website prototype to gain context, then switched to the implemented component to review a pair of graded papers that had been returned. For each test session, a video camera was used to capture participant reaction, while a separate video feed captured screen activity (these videos were later viewed and analyzed).

This usability test was designed to address specific concerns. A key concern involved instructor *use patterns* of the levels during grading. For comparison purposes, instructors were asked to grade a student paper by hand before using the computer prototype. Each instructor's by-hand grading showed that various passes were used when reading and commenting on papers, but the order was not necessarily audience-level comments, then organization, then mechanics. Analysis of their electronic grading showed that for all but one paper, each level was only visited once, i.e., there was not much jumping back and forth between levels. The participants did not express that they would need to significantly alter their grading methods to use the grading component.

A second concern that was explored involved the presentation of introductory help information. A guided tour was developed and presented orally to introduce instructors and students to the system. An insight gained

from this concerned the description given of the various tools available to instructors at the mechanics level. This description was purposely brief, and used the highlighter tool as an example to demonstrate the interaction users could expect (experiences from usability tests of the paper prototype indicated that it was difficult to demonstrate how a given tool could be used, without biasing a participant into believing that it was the way the tool should be used). Unfortunately, test participants tended to avoid all of the tools except the one that had been demonstrated (the highlighter). In addition to not allowing the usefulness and sufficiency of the tools to be gauged, it became clear that exploration needed to be better encouraged. For the next iteration of the prototype, we plan to show an extensively marked-up document during the initial system tutorial. The idea is that this will show the variety of marking tools available, without biasing how the tools should be used.

A third concern was the labeling of buttons on the toolbar. Test participants were confused by the use of the Select button, which allowed a previously-made comment to be reviewed or edited, and also the Remove button used to remove a previously-made comment.

Finally, both of the electronically-graded selections were rather short (80-150 words). Since the next phase of user testing will involve grading more papers and extended use of the software, patterns of usability problems may emerge. One participant felt it might be a problem for him and for his students to get the big picture, with longer papers - due to screen space - when only a relatively small portion of the text could be viewed at one time. It is thus not clear at this point if the application will be useful when grading or reviewing longer papers.

On the student side, a graded paper was presented to the student using the same three-level format, starting with the instructor's audience-level comments. In contrast to a paper as it is usually graded and returned, mechanics errors (which tend to be noted in place throughout the paper) are only visible on the mechanics level. Equally important comments about audience and organization are no longer constrained to narrow margins or relegated to the end of the paper, but found in a special commenting area on each level. This allows a student to review his or her graded paper in a more focused manner. An important insight gained from student testing was that it would be useful to present a graphical or statistical summary of the types of problems identified at each level. This was reported as needed, since specific local comments were visible only when selected for review, and the highlighter tool tended to be used in a variety of different ways.

5. Summary

To date, ten ESL instructors and seven ESL students have been involved in the prototype design, and an ESL instructor has been part of the design team from the initial brainstorming phase. This has been instrumental to developing an application geared specifically for the ESL classroom. Students from three HCI classes and one graduate student have been involved in project development thus far, and have gained valuable hands-on experience with usability techniques. Testing associated with traditional software development and our current use of remote user testing has provided, and will continue to provide, valuable feedback into the prototype design. Our experiences have shown that much insight can be gained by conducting user testing on web-based applications, where user tests are based on traditional techniques and emerging techniques that take advantage of new technologies.

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ExNet: An Intelligent Network Management System

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Abstract: In this paper, we investigate the use of artificial Intelligence techniques in the management of large-scale high-speed networks. We present a design of an intelligent network management system (ExNet) that efficiently and effectively monitors and controls the resources of a large scale computer network. The ExNet provides World Wide Web graphical user interface. We have implemented a rule-based prototype of ExNet and have incorporated ExNet modules with IBM NetView network management system.

1. Introduction

The current network connectivity has increased over the last decade. An explosive growth in the number of computers and the need to share information has triggered the development of computer networks. Moreover today's application demand a wide variety of services from the network. There are many different classes of traffic on the network and each traffic type has different quality of service requirements. All these applications assume that the network will provide them with the best possible service it has to offer. To provide efficient service to each application, the network must be operating efficiently at all times. If there are any network failures, they must be rectified immediately. Network failures cause various losses such as efficiency and productivity, and eventually manifest as monetary losses to both the clients and network access providers.

Current network management systems help a network operator to detect and diagnose the problems in a network. However as the complexity of today's networks increases, there is a greater demand for the network to be self managing. A self-managing system should be capable of automatically detecting and diagnosing the network problems. A capability to repair ordinary faults would also be desirable in such systems. In this paper, we present an architecture for an intelligent network management system, called ExNet. We use expert system technology to add intelligence capability to commercially available network management systems.

The organization of the paper is as follows. In Section 2, we present the ExNet architecture. The component modules of the system are described here. Section 3 covers the implementation aspects of ExNet prototype. The various subsystems we have developed are described. We conclude the paper in Section 4.

2. Architecture of an Intelligent Network Management System

Current network management systems are in general complex. They provide a lot of information and many different services. This has complicated the development of network management applications that utilize the services of these network management systems. The main goal of our effort is to apply expert system technology to reduce the severity of this problem and allow less experienced network operators to efficiently manage a large and complex computer network. Therefore we need a management system which will analyze the network and its services, and properly manage its performance. It must be intelligent enough to diagnose most of the faults as they occur and have the capability to suggest corrective actions. Despite this complexity, the system should be easy enough to use. For this we use a web-based technology to provide the required user interface [BEGG 94]. The use

of web-based technology enables us to provide a better graphical user interface to ExNet. Moreover this allows users to have a global access to ExNet resources and information any time and from anywhere with Internet access.

2.1 General Architecture

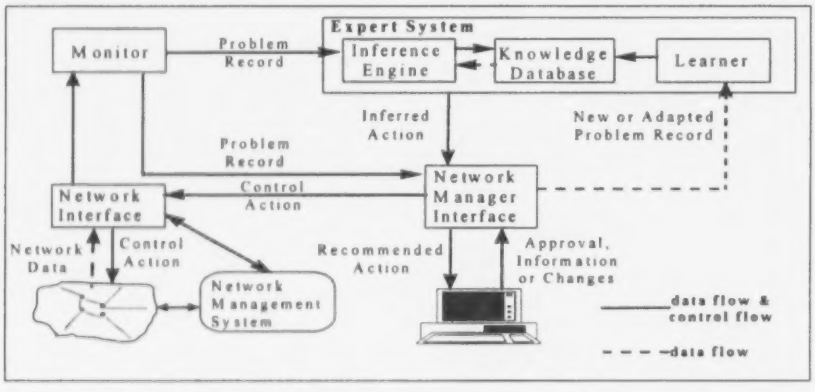

Figure 1 General Architecture of ExNet

The ExNet architecture shown in Figure 1 is composed of four modules.: Monitor Module, the Network Interface Module, the Network Manager Interface Module, and the Expert System Module. The "Monitor" is involved in monitoring the network. It keeps track of the changes that are occurring within the network. Further if it deems any event to be critical to the performance of the network, it reports the event to the expert system module. The "Expert System" performs an analysis of the situation provided to it by the monitor. Then based on its internal reasoning, it decides a specific course of action to alleviate the given problem. In this paper we investigate the use and applicability of both rule-based and case-based reasoning expert systems. The "Network Interface" is responsible for transferring information about events as they happen in the network. Also it will be responsible for implementing the strategies recommended by the expert system, and approved by the human manager. The "Network Manager Interface" will be the contact point between the human administrator and the ExNet system. This interface will present the information about the network, such as the current status of various nodes and links to the manager. It will also present the solution that the expert system module has come up with to the human manager. In what follows, we discuss our approach to implement these modules in more detail.

The Monitor Module

The Monitor module obtains and stores all the relevant information about the network. The information about the network will be obtained from a network management system. This information will come to the monitor via the network interface module. The information provided by the Network Interface will consist of either general events or special traps. The general events are reports on values of the observable parameters across the managed network. These reports are generated synchronously by polling each node. The special traps are generated by nodes when some extraordinary activity takes place in the network. These events include instances of network nodes going down or coming up, and a link either failing or a new link being formed. These are generated asynchronously.

After obtaining this information, the monitor makes a preliminary analysis to determine whether or not the given situation is abnormal. However it must be noted at this point that the Expert System is the final authority in determining if the current conditions are abnormal or not. For these cases all parameters are within normal ranges and do not represent any abnormal conditions. Since any network is expected to be performing normally most of the times, such a preliminary screening will serve to reduce the load on the Expert System, and consequently enhance the performance of the overall system. The cases which indicate slightly the possibility of an abnormal conditions in the network, will be passed on to the Expert System for further analysis.

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The Network Interface Module

The primary tasks for this module is to provide a seamless communication between any network management system (NMS) and the Monitor and Network Manager Interface modules. Consequently, this module transfers network data from the NMS to the monitor and also receives control instructions from the Network Manager Interface and delivers it to the NMS. The expert system may request additional information regarding the history of the system to reach a decision on the current problem. Moreover the network manager interface may obtain any information requested by the human network administrator. The events and traps, described earlier, are stored by the NMS in the "Event and Trap Logs." The information about the topology is stored in the "Topology Databases." The network interface can query these logs and databases for previously recorded information about the network. Apart from providing information to the other modules, the network interface is also responsible for implementing the actions recommended by the expert system and approved by the network administrator. The solutions that can be implemented will depend on the support provided by the NMS. It must be noted at this point that the network interface need not be entirely dependent on a network management system for functioning. The network interface can be implemented using the support provided by the operating system. Operating systems, such as UNIX, provide extensive utilities that can be used for network monitoring and management.

The Network Manager Interface Module

The main function of this interface module is to provide the human managers information, in a user-friendly manner, about network states and conditions and the expert systems' recommended actions. Also it takes directives from the user and converts them into instructions for other modules of ExNet. For example the user might want to query about the state of some particular node of the network. The most important interaction between this interface and the user is when a solution to the problem is presented to the user. The interface must be able to present all the facts pertinent to the current problem and should also specify the solution in a lucid manner to the user. The user's job will be to provide a sanity check to the proposed solution. The user may question the solution itself or may suggest some modifications.

The Expert System Module

The expert system module will analyze each scenario presented by the monitor, identify various problem symptoms, diagnose faults, isolate probable causes, and generate solutions. We use two approaches to design the expert system: rule based and case based reasoning methods.

- *Rule Based Expert System*

A generic rule-based expert system consists of a working memory, a rule-base, and a control procedure. The rule base contains all the rules about the problem domain. It is the knowledge base where the "expertise" of the system is stored. The knowledge base is represented as a set of rules. Rules are "if-then" structures. If certain criteria are met, then the system is to take certain action. The expert system's problem solving capabilities are directly dependent on the number of rules it has in its rule-base. By increasing the number of these rules, the expert system will be able to solve many and more complicated problems. The working memory contains the rules that are directly applicable to the given problem under consideration. These are the rules that need to be "fired" – executed since their "if" clauses have been satisfied. The system updates the working memory by asserting, modifying, or retracting working memory elements. For a network application, the working memory typically contains a representation of characteristics of the network related to the current problem, including topological and state information. The rule-base represents knowledge about what operations to perform when the network enters an undesirable state.

- *Case Based Reasoning System*

A case-based reasoning system is a powerful mechanism for exploiting past experiences in planing and problem solving. A case-based reasoner solves problems by applying previously successful solutions rather than generating a new solution to the problem from a scratch. The advantage of this approach is the ability to use the large-grained knowledge representation of "cases" - the previously successful solutions - rather than finer-grained rules, hence potentially enhancing the real-time performance of the network management system. Figure 2 shows the case based expert system.

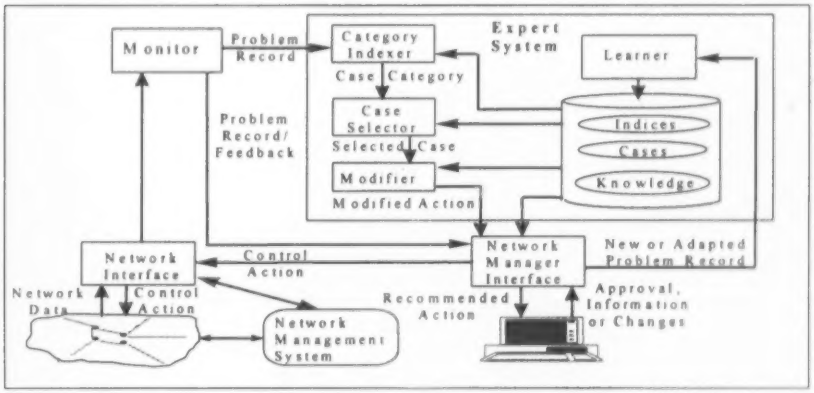

Figure 2 Case Based Reasoning Expert System

Learning new cases will also be required in order to support changes in network management practices, as demanded by the fast evolution in network technology, number of network elements, and support systems. A large number of cases will be identified to describe all significant problems that can be encountered in large scale high speed networks. We provide the system with a "case generalization" mechanism that will enable the system to modify previous cases to handle new problems. It does so by defining specific circumstances under which a case may "borrow" attributes from another case which is more or less similar case.

3. Implementation

We have developed a rule based expert system prototype, with rules for load monitoring and traffic routing. The Network Manager Interface has been implemented using web technology. Using the web-based interface we can perform basic network monitoring services. The network interface has been implemented using the IBM NetView/6000 for AIX Network Management System. The NetView/6000 is an SNMP based networking tool primarily meant for data collection in IP networks. It can also monitor various network parameters against previously defined thresholds and generate traps for network operators. We can use these traps to trigger other programs, such as the monitor.

3.1 Expert System Prototype

The prototype of the rule based ExNet is tested for a hypothetical network consisting of eight hosts and four gateways. Our aim is to simulate conditions for a real network and to route data between two given hosts. The system was built using CLIPS [GIAR 89]. The main tasks performed in this implementation were 1) monitoring congestion in the network by periodically gathering information on system status, 2) deciding whether the congestion has exceeded thresholds or not and what nodes are more congested than others, 3) choosing a new route for the data to be routed between the two hosts, and 4) suggesting a corrective action to the human manager.

The database containing the network information is provided by generating text files using IBM NetView/6000 for AIX. The monitor decides whether or not the problem in the current routing was related to performance or some system fault. Performance related problems include high latency, congestion or high system load. System faults include a crashed gateway or host. To determine a system fault, the monitor module would ping the host or gateway to inquire the status. The expert system analyzes the problem, requested more information from the network interface and after considering the alternatives decide on the new route to be implemented between the two given hosts. If there is a problem on an intermediate host/gateway, such as high load or too many users, the expert system would suggest a set of corrective actions to be taken.

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In this implementation example, we have used four main rules: 1) Check CPU State, 2) Check-Routing-ResponseTime, 3) Diagnose-network-status, and 4) Determine New Route. The first set of rules checks the loads on each computer to determine its load status. The heavily loaded nodes once identified are excluded from future path selections. The second set of rules evaluates whether the response time associated with the current network route meets the desired performance requirements. If the latency or delay is excessive and does not meet the user requirement, the current route needs to be changed. The third rule shows how the system can prevent nodes from sending new requests to highly loaded machines or network devices. The last set of rules compute a new path from the source to the destination. It first determines which gateways/hosts are still available for path selection. From the available gateways, the path with the least delay is selected.

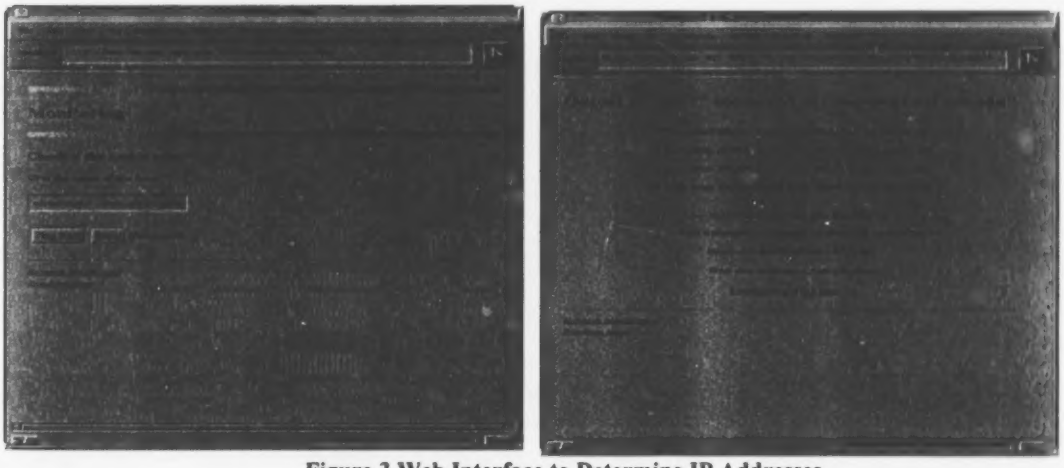

Figure 3 Web Interface to Determine IP Addresses

3.2 Web-based Graphical User Interface

We have developed CGI scripts to perform elementary tasks of network management over the Internet. We have also developed web interfaces to certain services offered by the IBM NetView network management system. The basic capabilities that we have implemented are 1) Ping: We can ping any host to check if it is alive and to determine the network response time, 2) Interface Statistics on a Host: This function is based on the *netstat* command in UNIX. It displays the traffic in packets per second for the given host, 3) Host Activity: It shows the current activities taking place on the host. It gives information such as the users logged on to the system and the system resources being used by each user, 4) IP: Given the name of the host, we can determine the IP address of the machine. An example of the interface for this service is given in Figure 3, 5) Name: given the IP address of a host, we can determine the name of the host, 6) Platform: This is used to determine the platform of the host, and 7) Operating System: This is used to determine the type of operating system running on a given host.

We have developed some scripts to run some NetView command and utilities. The commands used include 1) *xnmgraph*: We use this command to graph the traffic characteristics on each of the interfaces of the selected host. An example of the interface for this service is given in Figure 4, 2) *ovobjprint*: We use this command to obtain some system information about a host within the network managed by the NetView, and 3) *snmpColDump*: This command is used to display the traffic conditions recorded by the NetView on a host.

We also developed certain scripts that obtain and store in a text file the amount of traffic on hosts. These scripts are based on the *netstat* command in UNIX. *Netstat* command returns the total amount of traffic that has passed through its interfaces since the machine was booted last. Our script runs the *netstat* command on an hourly basis. The data returned by *netstat* contains the total number of input octets, total number of input collisions, total number of output octets and total number of output collisions. This data is stored in a file. Since we have the total traffic scenario on an hourly basis, we can obtain the hourly traffic scenario by simply taking the difference of the consecutive terms in the first data file. The corresponding hourly traffic data is stored in a second file. On the very

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first data collection of the day, another section of the same program updates a link in the calendar presented on the web.

We have also configured IBM's NetView/6000 to trigger software applications, such as ExNet, on receiving certain events from the network. In a SNMP based scenario that we are considering, the health of the network is monitored by the SNMP agents by measuring some parameters, such as load on a computer or traffic passing through a router. Some of the network activities may overload the system. In such a case, the overload will cause some network parameters to cross the previously defined threshold of acceptable values for these parameters. On detecting any an abnormal condition, the SNMP agent responsible for that particular host or node will generate a trap. This trap will be received by the NetView daemons on the management station [CASE 90]. These daemons will trigger the ExNet System by passing the appropriate parameters concerning the event. ExNet will then decide on the corrective measures to be taken.

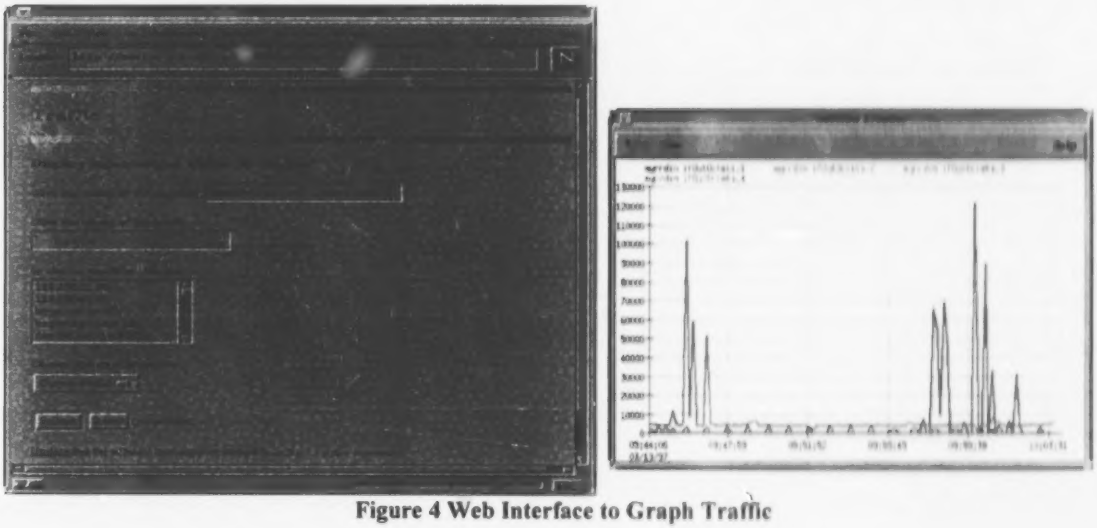

Figure 4 Web Interface to Graph Traffic

4. Conclusion

We have presented two approaches to implement the expert system module of the ExNet prototype to achieve intelligent network management. These two approaches are rule-based and case-based expert systems. We have implemented the rule-based expert system in our prototype. It is efficient for problem solving in domains that are constant and where the expertise for solving the problems is relatively fixed. Unfortunately, today's networks are dynamic with new components, new technologies, new protocols and new applications being introduced routinely. Case based reasoning approach provides an interesting approach to address these limitations. We are planning to develop an intelligent network management system using case-based reasoning and also improve the web-based graphical user interface to support a wide range of control and management functions.

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Implementation of Multipoint Multimedia Conference System for Electronic Document Interchange Using Object Modeling Technique

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Abstract: Implementation of efficient business processes is critical to increase organizational effiency of a company. In order to change document delivery method and manager's approval process, LAN and ISDN based video conference system was implemented. A user of the system can simultaneously watch documents with remote people and decide whether the documents are approved. To implement the multipoint multimedia conference system including a MCU(Multipoint Control Unit) operation/management system, a security server and conference reservation software, object oriented software analysis and design method is adopted. Object model and dynamic model were used to reuse the designer's analysis and design experience of previously developed software.

1. Introduction

LAN and ISDN based video conference system was implemented to increase the effiency of a business processes and to change document delivery method and manager's approval process. When approving a document, a user of the system can colloborate with remote people.

In the case of developing several systems that have similar functions, using the methodological software development technique like object modeling technique is a way to make developers easily reuse the analysis and design result as well as source code of the system.

To implement the multipoint multimedia conference system development, a object oriented software analysis and design method is adopted. During the iterating software development phases of design, analysis, implementation and maintenance(Fig 1.), the relation of objects that compose a system is described by object model and the life cycle of the objects is represented by dynamic model. Functional model of our multimedia conference system isn't necessary to increase the reusability of analysis and design result, because video conference system isn't data transformation oriented.

2. Software Development Process Using OMT

Software development process can be devided into four stages like object oriented analysis, object oriented design, object oriented programming and maintenance. These stages are iterated as the system requirements are changed throughout the development process.

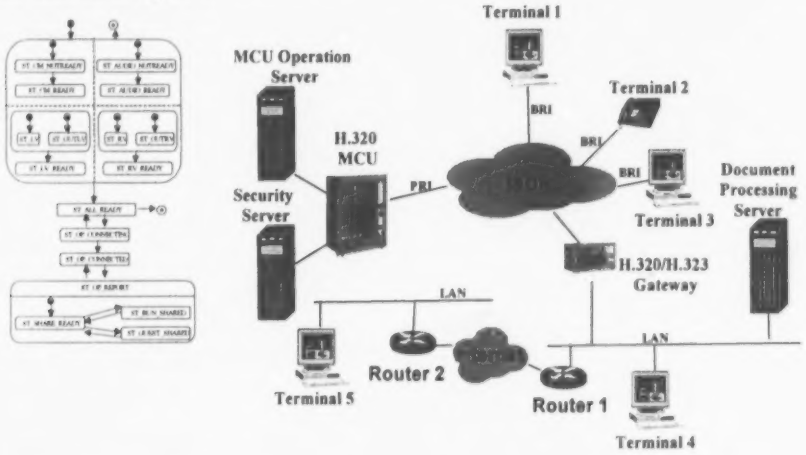
During the object oriented analysis stage, domain problems are decribed and requirement model is developed. To build requirement model, a static structure of system(object model), a event sequence(dynamic model) and data transformation(functional model) are specified. The 'static structure' defines the relationship between system elements and the 'functional model.' The principle funtion of video conference software are the transmition of video and audio signal, it rarely does data transformation. Building object model and dynamic model is more important than doing functional model.

During the object oriented design stage, development methods of object model are determined by adding objects needed to implement object model. The object oriented design stage comprises system design and object design. During the system design, specification of system element is determined. Classes to be implemented are defined and interfaces and algorithms to be used are decided.

After completion of design, object oriented programming language is used to implement the system. Ojbect model is corresponded to class to be implemented. The relationship between objects is defined as a property of class.

3. Ojbect Modeling/Dynamic Modeling

Video conference system connects and disconnects a call, transmits audio/video stream, reports a document, transfer a report, waits a call and changes the video displaying position. Objects of video conference system are local video, remote video, volume control, report share, report transfer, destination address and report.
In dynamic Modeling, STD(State Transition Diagram) and event diagram are used to present state chagne and transmitting/receiving event sequence. A state transition diagram of CofnerenceDlg object and the overall system are showed in figure 1.



(a) A State Transition Diagram of an ConferenceDlg Object (b) Elements of Multimedia Conference System For Electronic Document Interchagne

Figure 2 : A State Transition Diagram of an ConferenceDlg Object

A terminal on ISDN can do 1:1 video conference or multipoint video conference with the help of MCU. It can be connected to terminal on LAN through a H.320/H.323 gateway.

4. Conclusion

In developing a multipoint video conference system, object modeling technique was adopted to preserve the results of system analysis and design in the formal way of expression and to reuse them. It will helpful to analyze the developed system and to improve the effiency of system development. In this paper, an example of system development using object model technique is shown to share the experience of analysis and design of system.

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Update Policies for Network Caches

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Abstract: The Internet continues remarkable and seemingly unregulated growth. This growth has seen a corresponding increase in network loads and user response times. Network caches are designed to alleviate these problems imposed by ever-increasing Internet traffic growth. Caching acts out a vital role in the performance of any large-scale distributed system and is becoming an increasingly important research topic within the Internet community. There have been much work in this area, especially focused on caching policies and cache consistency. However, those have been researched and treated topic by topic without providing a systematic view of network caching itself. We address this problem by proposing cache performance metrics and taxonomy of caching policies. In this context, we suggest two caching policies for higher hit-ratio and better consistency. One is the multi-level TTL-based expiration policy and the other is the periodic update policy. Although the former has been used in many real-world caches for some years, there are no recommendations for TTL values based on experiment or analysis, what we will show in this paper. The latter is for better cache consistency, which is also the one of critical issues, by checking cached objects and updating. Those policies are designed and experimented based on cache workload characterization to reflect users' cache access characteristics and we could gain significant performance improvement. Their prototype implementation is shown and future issues are discussed.

1. Introduction

1.1 Cache

The Internet has revolutionized the way in which information is accessed and distributed globally[Povey 95]. It's growing at an exponential rate. Especially, by all indications, the World-Wide Web[Berners-Lee 92], or WWW continues its remarkable and seemingly unregulated growth. As the number of users and hosts grows rapidly[Gray 97], network load, server load and latency problems occurred. Because software developers perceive network bandwidth and connectivity as free commodity, Internet information services like File Transfer Protocol (FTP), Gopher, and WWW were designed without caching support in their core protocols. The consequence of this misperception now haunts popular WWW and FTP servers. To alleviate these problems of network information services which has inherently unscalable model, network caching is widely used to reduce both latency and network traffic in accessing data nowadays. Caching is particularly suited to the World-Wide Web where many of the object are small and are modified frequently[Wessels 95]. The idea of cache is that distributing the publication responsibility through the deployment of network caches gives us the quickest route to a medium term solution.

1.2 Cache Performance and Caching Policy

The use of intelligent caching to prevent redundant transmission of documents will reduce unnecessary bandwidth consumption. The purpose of caching policies is to make caches more intelligent and improve performance. Generally, well-known metrics of cache performance are hit-ratio, latency and consistency. Since hit-ratio is directly related with bandwidth saving, higher hit-ratio would be the most important goal of caching from cache operators' perspective. From user's perspective, low latency and perfect consistency would be most desirable when he requests an object on the network. From information provider's view, a caching scheme needs to guarantee cache consistency, perhaps to as high of a degree as, to provide up-to-date information. However, since consistency problems always arises when using caches, additional mechanisms are indispensable for better consistency with current caching model. This paper will suggest two caching policies for higher hit-ratio and better consistency and show how much gain we could get from them.

2. Caching Policies

2.1 Caching Policies : Taxonomy

Because caching policy is directly related with cache performance, its importance has been emphasized again and again in many other papers. However, those dealt with just a specific policy, e.g., replacement policy or removal policy without providing taxonomy or top-down view. Before suggesting our 2 new policies and show their effect on cache performance, we present taxonomy of cache policies based on their relation with cache performance and the order we applied to.

- Level 0 : No caching
- Level 1 : Removal policy (when storage space is full, for higher hit-ratio)
- Level 2 : TTL-based expiration policy (per object, for higher-hit ratio and better consistency)
- Level 3 : Update policy or replacement policy (periodically, for better consistency)
- Others : Large-file caching, caching with minimum delay, ...

Since cache storage space is finite, first of all, removal policy is indispensable for making a room for new objects. As in many other previous works showed, this policy is mainly for higher hit-ratio. LRU, LFU or combinations of them is known as good algorithm for it. TTL-based expiration policy is located in another dimension compared with traditional removal policy. What's the distinction between them? Time and their effects on performance. TTL is given per object basis when an object is requested and it's not related with amount of available free storage space(of course cache operators can set TTL values differently depending on total cache storage space. But it's a kind of system management issue). So it would be better to consider it as a policy on another level, not as a competitor of traditional removal policies executed when storage space is full, e.g., LRU or LFU. Moreover, originally, TTL-based expiration policy was used for addressing consistency problems in distributed file systems' cache. It's not indispensable but useful because cache operator can control each objects' lifetime and consistency. However, tuning TTL values for higher hit-ratio and better consistency is a kind of common, but not-easy-to-solve problem. Depending on how operator set these values, hit-ratio and consistency of cache can vary significantly. Update policy is another useful policy for better consistency. Our approach is as follows. "We set TTL values to get higher hit-ratio without considering its effect on consistency. Instead, use additional update policy for better consistency". After giving more detail explanation and state-of-the-art of each policies researched so far, we will present our approach.

2.2 Removal Policies

For more intelligent and high performance caching, there has been much attention and research on caching policies. However most of them have been focused on removal policies since the cache has finite storage and removal is indispensable. There are three issues for removal policies: what to replace, when to replace and how many documents to remove[Williams 96]. Though caches have no right to select objects to be cached, they can select victims to be purged or refreshed when storage space is full. So one of the most important goal of removal policies is selecting victims to be purged for higher hit-ratio. The problem is essentially one of guessing, among the documents currently in cache, which one is the best to remove in order to make room for new documents[Lorenzetti 96].
Variable document sizes and types allow a rich variety of policies to select a document for removal, in contrast to policies for CPU caches or demand paging, that manage homogeneous objects[Williams96]. Considering the problem of selecting objects to be purged for higher hit-ratio, some useful hints can be derived from similar works issued in the field of file-system caching. Commonly used policies include Least Recently Used(LRU), Least Frequently Used(LFU or NREF), policies based on the size of objects, or combinations of them[Lorenzetti 96]. The fact that LRU or LFU algorithm works well indicate that recency and frequency of past document accesses are strong predictors of future document access. Overall, recency proved to be a much better predictor than frequency[Pitkow 94] and generally hybrid LRU-LFU policies allows to exploit the object access history better than LRU[Lorenzetti 96]. The size of objects, which is related with the type of information, also can be used as a primary key when we address the issue of how many documents to remove.

2.3 Multi-level TTL-based Expiration Policy based on User Access Pattern

The problem of when to run removal process has been addressed in the following ways in the literature: On-demand, periodically, both on-demand and periodically[Williams 96]. In addition, there has been a widely used way of

removal from cache space in real world called 'TTL(Time-To-Live)-based expiration mechanism'. Originally, the purpose of TTL policy was for maintaining cached objects' consistency simply in the field of distributed file system caching. Although network cache software, Harvest and Squid supports TTL-based expiration mechanism and there has been much work on removal policies when disk space is full, there are no recommendation for TTL values derived from experiment or analysis. So many caches operating in real world are not making use of the benefit of this mechanism enough and operators usually setup TTL values by their own naive heuristic. This paper suggests the 'multi-level TTL-based expiration policy based on user access pattern (cache workload characterization) and file type' for higher hit-ratio and shows how much gain we could get from it.

2.4 Periodic Update Policy

A consistency problem always arises when using caches. Consistency is also an important metric of cache performance. Works on cache consistency have been considered from three different standpoints: client's [Dingle 96A], cache's[Wessels 97B] and server's[Berners-Lee 96]. Ideally, clients and servers should have adopted explicit and efficient mechanisms to communicate each other for maintaining consistency. However, when HTTP 1.0 was designed and introduced, they didn't give network cache a serious consideration. Because just client's built-in cache, whose storage space is at most 0.1 ~ 1% of network cache's, was under consideration, they had no reason to take consistency problem seriously - Expires, Last Modified Time header and If-Modified-Since request was thought to be sufficient -. That's the reason why network caches, relatively new born baby, bears the whole responsibility for consistency, at least in these days.
Actually, works from standpoints of client's and server's are kinds of long-term issues which should be followed by some major modifications and improvements on core protocol. Moreover, not only clients and servers but also network cache should be considered seriously for designing new protocol, such as HTTP 1.1 evolved from the HTTP 1.0. While HTTP 1.0 proxy caches typically maintain cache consistency in an ad hoc fashion, the HTTP 1.1 explicitly defines cache consistency and describes an expiration/validation model which caches may use[Dingle 96B]. Apart from these on-going researches for making new standard protocol and their experiments, real world caches are making use of TTL-based expiration or refresh mechanism in maintaining consistency nowadays. These approaches, including HTTP 1.1's, and cache consistency itself is tricky in that no one can predict objects' lifetime. To make matters worse, TTL setup for higher hit-ratio will bring poorer consistency. Most of cache operator's are concentrated on higher hit-ratio rather than better consistency, as information providers don't provide Expires header value.
In this situation, we can get some useful hints from consistency mechanism used in the field of distributed file system and information sharing tools on Internet. Usually, in distributed file systems, TTL-based expiration mechanism and server-initiated invalidation methods have been used for data consistency. Server-initiated invalidation has the weak point in the aspect of scalability unless a specialized grouping mechanism is not supported. However, mirror, a kind of tool for periodic asynchronous replication on the Internet has the advantage of guaranteeing 'no more stale than predetermined time interval'. This approach can be adopted directly by caches since no modifications on clients or servers are necessary. We name it periodic update policy and suggest for cache's better consistency without lowering hit-ratio gained by any other policies, for example, TTL-based expiration policy.

3. Multi-level TTL-based Expiration Policy and Periodic Update Policy

To analyze users' cache access pattern first, we gathered 7-days' log files from our cache, cache.kaist.ac.kr. It had processed 1.16 million requests on 0.4 million URLs which amounts to 8.04GB and serviced 18.94GB for a week.

3.1 Multi-level TTL-based Expiration Policy based on User Access Pattern

TTL values should reflect user's cache access pattern for high hit-ratio. Especially, inter-access time of cached objects is critical. Since all cached objects are not requested more than once and storage space is limited, TTL policy should expire objects which have not been requested again for some time interval.

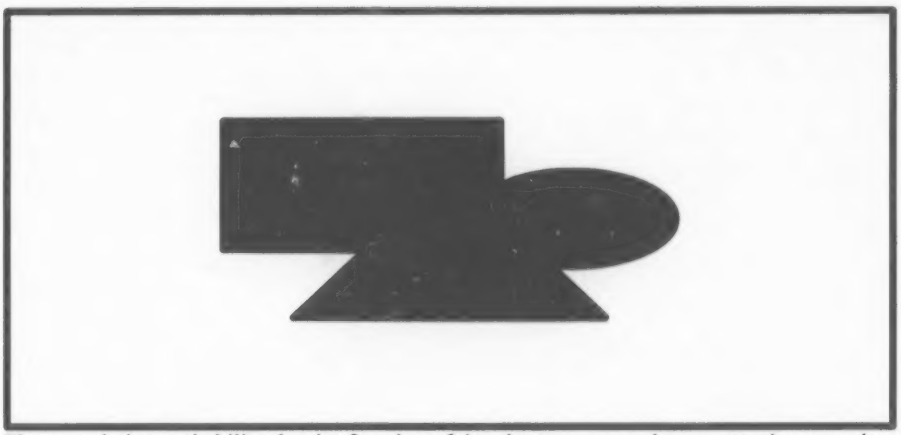

Figure 1: The cumulative probability density function of time between second request to the same document after first request

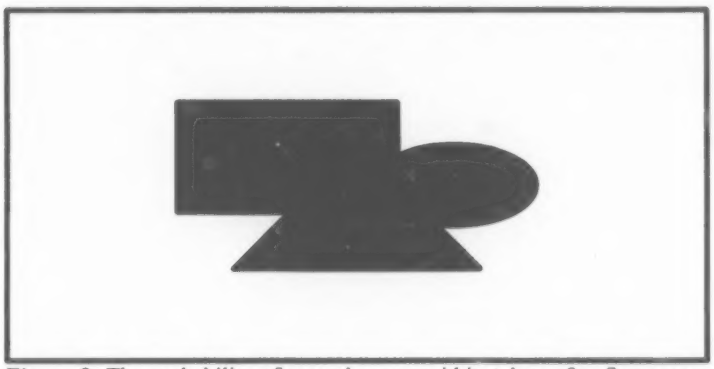

Figure 2: The probability of second access within *i* days after first access

From figure 1 and 2, we can derive a conclusion that cache should keep documents at least for one day because about 70% of second accesses to objects in cache occurred within one day. It's in keeping with Pitkow's analysis, "the most important data for a caching algorithm is the pool of documents accessed one day ago" [Pitkow 94]. Additionally, we should take in mind the cost of fetching document. That's why the multi-level policy is necessary and its basic idea is "The longer TTL for larger objects." Generally, TCP connection request pattern is dominated by a 24-hour pattern[Paxon 93]. So is cache access pattern. Since request pattern on caches have a similar cycle with daily or weekly office time of users(at least save objects it for one day and if it has not been requested for more than about a week, it won't be requested again. Moreover, as in figure 4, cache access pattern itself reflects users' daily or weekly office time.), we give relations between object size (file type) and these cycles. Here is our suggestion, multi-level TTL-based expiration policy based on user access pattern and fetching cost.

- No Caching : for dynamic objects, copyrighted objects
- Caching for a day : text documents (small objects)
- Caching for a week : Image, movie, audio, executables, compressed, FTPed objects (large objects)
- Caching for a month/year : Very large files (very large objects, not necessary at this time)

According to the above policy, we setup TTL values in the configuration file of cache software Squid 1.0.20 as follows.

- Private or dynamic objects (.shtml, .phtml, .cgi, ...) : No caching
- Text objects (.txt, .html, .htm, .cap, ...) : cache for a day
- Images (.gif, .bmp, .jpg, .jpeg, .xbm, .png, ...) : cache for 2days
- Movie, audio, executables, compressed, FTPed objects : cache for a week
  (.mov, .mpg, .mpeg, .wav, .mid, .qtm, .avi, .viv, .zip, .lha, .arc, .arj, .rar, .tgz, .gz, .tar, .exe, .pdf, ...)
- Others : cache for a day

TTL value for images is not a week but two days because our cache's storage space was not sufficient(6.6GB) for storing documents requested for seven days(8.1GB).

3.2 Periodic Update Policy

Motivation of periodic update policy is the better consistency at the sacrifice of additional bandwidth usage. Not to waste bandwidth and processing power unnecessarily, we should be careful in selecting objects which deserves to be checked and updated. There are two issues in designing periodic update policy - What should we check and update? When should we do?

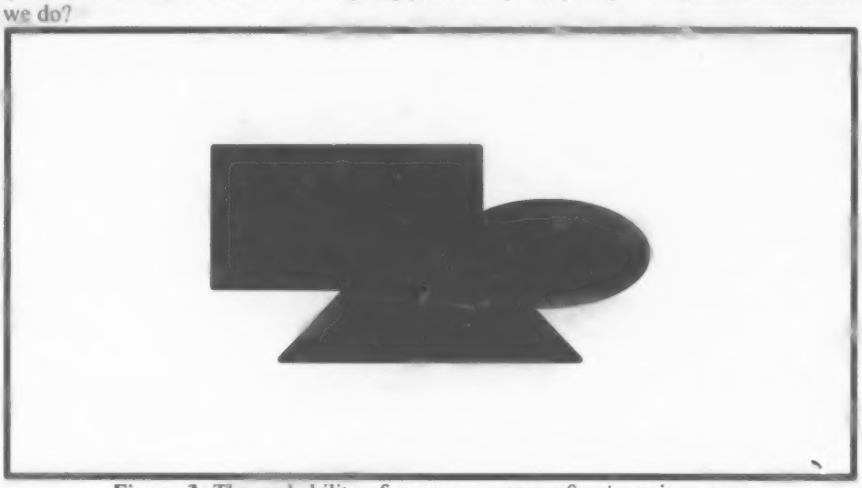

Figure 3: The probability of one more access after *i* previous ones

"What should we check and update?". According to our analysis, as in figure 3, the probability of one more access after two previous ones was 55%, much higher value compared to that of after one previous access, 34%. It shows that frequently-requested objects in the past are likely to be accessed more and more in the future. It would be reasonable to check and update objects with more than at least two previous accesses, depending on system and network resources.

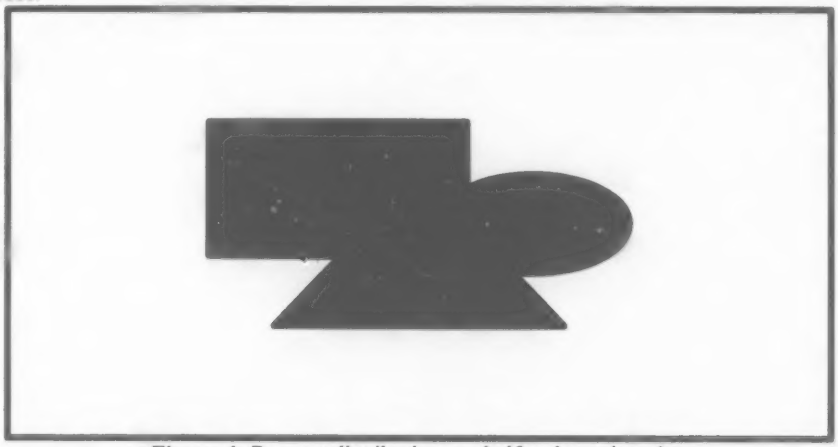

Figure 4: Request distribution per half an hour, in a day

From figure 4, we could derive the conclusion on the issue of "When should periodic update take place?", before the dawn, not in the daytime.

According to above analysis, we made a prototype implementation as follows.

- Start periodic update policy module at 1:00 AM everyday
- For each cached objects which has been accessed more than once, check whether it's consistent with

original data or not.

- If they're not consistent, update cached objects.

We can define the reliability of cache as :

Reliability(%) = (number of consistent objects) / (number of checked objects) X 100

4. Analysis

4.1 Multi-level TTL-based Expiration Policy and Hit-ratio

We have tested our own multi-level TTL-based expiration policy from 1996.10.7 to 1997.2.7.

Figure 5: Byte hit-ratio of cache.kaist.ac.kr(1996.7.21 ~ 1997.2.7)

Before 1996.10.7, we were using default TTL values provided by Squid software package with no modifications as follows.

- Dynamic document (.cgi) : No caching
- Images (.gif) : cache for 2 days
- FTPed objects : cache for a week
- Others : cache for a day

The major fault with this default setting is TTL values of HTTPed objects other than gif images. Although TTL value of FTPed objects is same as ours, the portion of FTPed objects is merely 10% of total transferred objects. Our multi-level TTL-based expiration policy based on user access pattern and fetching cost divided the other 90% of HTTPed objects into appropriate classes for managing cached objects, and we could gain about 10-15% higher hit-ratio as in figure 5.

4.2 Periodic Update Policy and Reliability of Cache

We checked consistency for objects accessed more than once, tested periodic update policy for a week and calculated the each day's reliability of cache. Result is as follows.

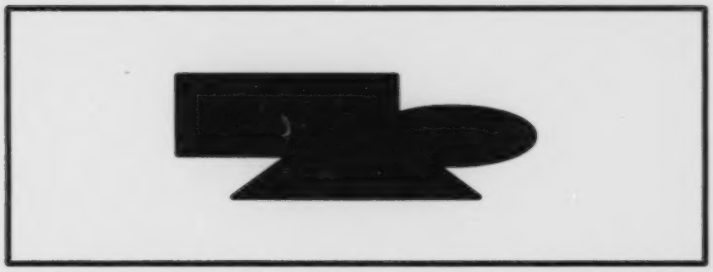

Table 1: Reliability of cache.kaist.ac.kr (1997.5.26 ~ 1997.5.31)

The column 'Don't know' means we couldn't check objects' consistency because their original server didn't provide 'Last-Modified-Time' information. Some (about 5~10%) Web sites seem to be operating with old Web server program and their proportion will be diminished as time goes by. So we excluded them in calculating reliability.
In the first day, reliability of cache before executing periodic update module was the lowest(93%). After executing it once, reliability have been over at least 95% for a week. With periodic update policy, we could get higher reliability as well as guarantee maximum staleness of cached objects, better consistency. How about additional bandwidth consumption? Since the percentage of modified objects is 2~5% of checked objects and checked objects is about 33% of total objects in cache(according to our analysis as in Figure 6), additional bandwidth consumption caused by updating modified object is at most 1.5% of cache size. The word 'at most' is based on the fact that small objects like text or html objects less than 5~10 KBytes are changed frequently than larger video or audio objects. When the size of cache is so large and the amount of modified objects becomes too much, we can tune periodic policy to decrease the number of objects to be checked. It's up to cache operators.

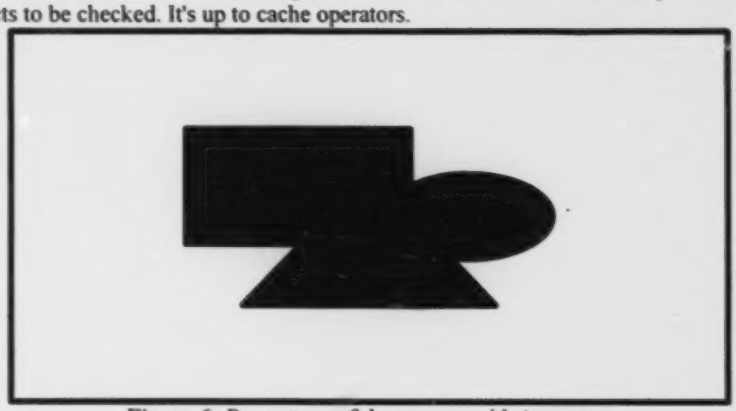

Figure 6: Percentage of documents with *i* accesses

By using our periodic update policy, we could get better consistency(always over 95% of reliability) at the sacrifice of negligibly small amount of additional bandwidth consumption.

5. Conclusion

In this paper, we have presented taxonomy of caching policies and two new policies in Web caching area : multi-level TTL-based expiration policy based on user access pattern and periodic update policy based on users' access pattern. Multi-level TTL-based expiration policy and periodic update policy resulted in performance improvement on cache: higher(about 10-15%) hit-ratio and better consistency. These are based on the fact that recency and frequency of past document access are strong predictors of future access. Using these policies, we can make adaptive caching based on periodic analysis of past user access pattern. This adaptive approach would enable automatic tuning and high performance caching without additional management overhead.
Caching always brings consistency problems. We measured the degree of a cache's consistency by defining reliability and showed that with our periodic update policy, we could get acceptable increased consistency. Since the idea of reliability and periodic update policy is similar to that of asynchronous replication, caching with periodic update policy can be viewed as an initial attempt to mix caching with replication. Replication has been important in dealing with large or very large files on the Internet efficiently. As the average size of objects on the Internet is getting larger and the number of large multimedia data increases, caching shall evolve and include the mechanism of replication. Caching large files will be a critical issue in the near future. Actually most caches do not deal with large files(>100 MBytes) to avoid inefficient utilization of storage space. They are just purged from cache space after

satisfying client's request.
Periodic update policies can be applied to entire cache network for lower bandwidth usage during update time. In this case, it would be better for each caches to exchange their candidate list and update common objects simultaneously. If a cache network system works as if an asynchronous replication group like this, consistency problem of cached objects between each caches in hierarchy could be solved by similar method. Since consistency is directly related with the quality of data and users usually don't want out-of-date data, data inconsistency of caches in hierarchy is also the one of the most important issues to be resolved

This paper has focused on the performance and policy issues of a cache. Since we are going deep into the study of cache network and experimenting on Korea cache hierarchy[Cache-KR 98] and APAN (Asia-Pacific Advanced Network)[APAN 98] cache hierarchy, our research work about cache network will be published in the near future. This work is by no means final.

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Web Based Application for Multipoint Collaborative Conference

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Abstract: Korea Telecom makes plans for multipoint multimedia services. As a basis for implementing multipoint application service scenarios, there are many factors to be considered. Although multimedia conference applications can be implemented using Internet, Current Situation has problems to commercialize. In this paper, service prototype is proposed for multimedia conferencing application services based on audio-visual communication and data collaboration work using web environment based on ISDN and Internet

1. Introduction

Within the recent years, World Wide Web(WWW) has gained broad acceptance to provide information . Further, Web based data collaboration that is whiteboarding, multipoint binary file transfer, shared computer applications and document files, etc and audio-visual communication in the multipoint connection environment is hot issued so IETF develops Real-Time Transport Protocol(RTP) and Mbone Multimedia applications etc. However, it is difficult to make commercial conference application service in Internet because of bandwidth limitation.

Service prototype is developed by hybrid infrastructure. Ordinary URL data is transmitted by Internet but data collaboration and audio/video stream data is transmitted by ISDN. Service prototype is shown on multipoint environment which consists of applications, user management and MCU operation parts. Applications is developed in compliance with ITU-T T.120 and H.320 recommendation for the purpose of meeting or collaborative work etc. MCU operation module play roles for conference scheduling conference control etc.

2. Web based system for multimedia conferencing

Web based application is developed by using Java script and PDK tool under NetMeeting environment. Throughout Netmeeting conferencing API, H.320 module which consists of call control, mediastream format and audio/video codec is performed and T.120 modules which consits of application protocols, generic conference control and multipoint communication service is application protocol an which give an example MBFT, whiteboard and application share is performed.

Using Web browser, user retrieves events in order to join conference or can create new conference for the purpose of meeting. After call set-up procedure is performed by using D channel between terminal and network, then establishment between terminals is performed by using 2B channels in order to transmit audio/visual stream and data collaboration.

MCU is a kind of centralized switching equipment which performs video switching, audio mixing and data routing for multipoint multimedia conferencing. So MCU is used for establishing between three or more terminals. Each Web based conference terminal can call MCU or MCU can call each terminal to hold conference. Service prototype configuration is as flowing figure 1.

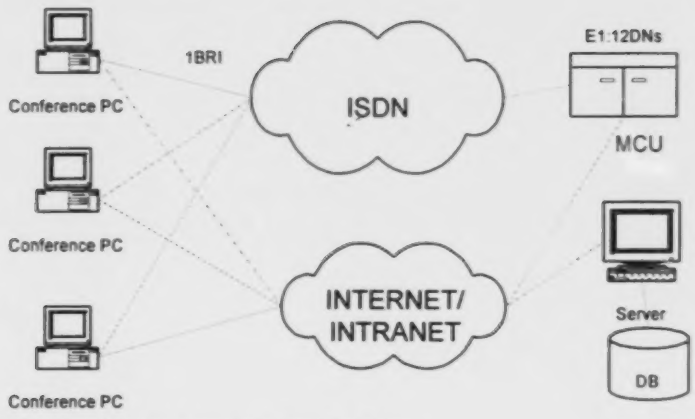

Figure 1 : Service Prototype Configuration

3. Experimental Issues

In order to evaluate this service prototype, experiment is performed as flowing. Firstly to investigate multipoint performance, from 3 port to 9 port multipoint conference test is performed both voice activation and continuous presence environment whether it support data sharing including application s/w share or not. In addition to, simultaneously two or more conference is tested under same condition. And interworking test is preformed between terminals or terminals and MCU. Secondly, camera plays important rules in video conferencing for video quality. To examine video quality according to camera level form low quality to high quality camera test is performed. Thirdly, PC performance has effect on data and video transmission. From low up to high performance PC is tested. User requirements are investigated for GUI environment. Throughout this experiment, application sharing is not so much good in view of interactive performance

4. Conclusion and Future work

Throughout evaluating service prototype with many kinds of aspects, we meet with results for multipoint multimedia application service. This result will be systematized and used as good reference in making various kinds of application services for the purpose of business. And our future work will focus on the full implementation of this prototype. Particular emphasis is put on data collaboration part to support more quickly interactive respond.

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Assessing the Quality of Telecommunication-Based Instruction

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Overview

This research effort concentrated upon participant outcomes resulting from the use of interactive television mode of distance learning. This instructional methodology employs video and audio links from an on-campus classroom to one or more remote sites. The research addressed the following questions:

1) Are there differences in on-campus and off-campus grades when courses are taught using interactive televised distance learning?
2) Do interviews, observations, and other informal methods reveal differences in participant attitudes or other outcomes related to interactive televised distance learning?

Interactive televised distance learning is an expensive methodology that serves very large participant populations in networks throughout the world. However, research upon participant outcomes related to the use of this technology is minimal and therefore becomes the focus of this study. The intent is that any participant outcome concerns identified by this research will serve as companion pieces to efforts directed toward improvement of interactive television course content, instructional methodology, and delivery systems. Unless research vindicates the application of interactive televised distance learning with respect to its instructional outcomes, than an open-ended argument exists.

The research was based upon student survey inputs, final grades received by on-campus and off-campus interactive televised distance learning students, and face-to-face interviews with students, faculty members, instructional developers, members of the operating staff and administrators.

Results

An independent samples t-test for differences between the total number of final grades received by on-campus interactive televised distance learning students during the period from the Fall of 1991 to the Fall of 1997 (1227) and those received by the off-campus students during the same period (628) yielded a t-ratio of 6.196 ($df = 1853$, $p<.001$) indicating that the means differed significantly. The off-campus mean was 3.41 and the on-campus mean was 3.14 indicating that, based upon final grades, off-campus interactive televised distance learning students had higher final grades then their on-campus counterparts.

Conclusions

To conclude, distance learning in general, and interactive televised distance learning in particular are options available to the student. Each student must evaluate the outcomes related to the selection of educational alternatives -- to study on-campus or to study off campus. If off campus, should the offering be accessed via interactive televised distance learning, the Internet, or a correspondence course? For each option the considerations of cost, difficulty, and educational value are important. This research indicates that interactive televised distance learning is convenient for the off-campus student, provides guidance in the form of a detailed syllabus, and results in an opportunity for a final grade that will not be less than one could expect from on-campus attendance and, depending upon the area of concentration, may be higher than the on-campus participants.

In an era where the boundaries an educational institution can serve are now the world, and where competition to serve this audience is becoming extreme, the results of this research should be expanded upon to maintain the competitive position of those institutions in which interactive televised distance learning is an important element in their educational mix.

Efficient Searching, Analysis, and Visualization of Internet Data

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Abstract

An approach to improve information retrieval from the Internet is described. It is well known that the Internet contains valuable information. However, locating the information is time consuming since an user must sift through large volumes of data and wait through Internet delays. Typically, an user issues a request to a search engine such as Altavista, Lycos, or Yahoo. After scanning through the first few pages of URLs returned by the search engine, the user picks a few URLs which appear to be interesting. The problems with this type of search are - the user is dependent on the relevance ranking of pages by the search engine, the search is shallow since a small list of URLs is retrieved, and the user is subject to Internet delays while retrieving the list of URLs from the search engine *and* accessing web pages. We have solved some of these problems by searching multiple search engines offline and providing a variety of tools to scan through the retrieved documents. With the tools we describe in this paper, a much broader search for a topic on the Internet is possible with less user time.

1 Introduction

Much of the world's stored data is in the form of text documents and we have time to read only a fraction of it. We need sophisticated tools to navigate through the mass of documents and extract information of interest to us. Search engines such as AltaVista, Lycos, and Yahoo have become very popular tools to search the Internet. However, due to their popularity and the requirement for short response times, the search engines do not perform any sort of analysis beyond a preliminary ranking.

Many of the queries answered by the search engines are shallow, i.e. a small percentage of the URLs indexed are returned by a search engine per query. John Naumann, Infoseek's vice president estimates that most queries are answered by the 1 million most frequently accessed pages - only 4% of the whole index of Infoseek listings. Further, no two search engines respond to the same query with the same top ten URLs in all cases. Due to time constraints, most users retrieve a small fraction of the relevant documents from a single search engine. It takes a considerable amount of time to obtain more than 100 URLs from a search engine and scanning each of them for relevance can take even longer.

A much broader search can be accomplished using our application. We have avoided the problem of bandwidth by running Internet queries offline. Data in response to queries is stored locally. Analysis is also performed offline and the user is notified by e-mail when a query has been processed. Interactive analysis of the data is performed by the user on data stored locally. The text data corresponding to each URL from the search engine is retrieved, if possible. Our analysis and visualization tools are based on the stored text data.

2 Query

The query process is the first step in the retrieval of information from the Internet. Our software handles the query of multiple search engines offline. Queries can be scheduled to run during non-peak hours.

Since Internet delays in accessing web pages is unavoidable given the current volume of network traffic, our application uses the GNU tool wget [Niksic 97], to scan multiple search engines offline. A single query is issued to multiple search engines sequentially. The results from each search engine are collected and stored in tables. Duplicate URLs are eliminated.

The page corresponding to each URL is retrieved offline and stored locally. Only the text data is currently stored. The maximum limit of URLs for a ranked query from Altavista is 200 and we have used that limit for the other search engines as well. The three search engines that we used were Altavista, Lycos, and Webcrawler. Therefore, a maximum of 600 URLs could be retrieved per query. This limit may be exceeded, if the query is submitted periodically. A query can be scheduled to run automatically at a particular time daily, weekly, or monthly. New documents will be identified and added to the list. Therefore, the list of URLs can grow with time.

A document (web page) is represented using a sequence of keywords. Each keyword has an associated weight representing the importance of the keyword in the document. A weight is assigned to the keyword based on the frequency of occurrences of the keyword in the document. After the weights for all the keywords for a particular document have been tabulated, a normalized weight is computed using the sum of all word frequencies. A maximum of 100 keywords were used to represent a document. A stopword list was used to remove high frequency keywords such as and, or, is, etc. We also used a public domain stemmer [Porter 80] to remove suffixes from keywords. This indexing scheme for building document vectors was simplistic. Some terms appeared in many documents and therefore were not valuable in characterizing the content of a document. We used the inverse document frequency weight (see section 3.3) to more accurately discriminate between documents. The weight of a keyword was inversely proportional to the number of documents in which it appeared and the frequency of occurrence in a document.

3 Analysis

The analysis process builds a similarity matrix for all pairs of documents, runs the clustering algorithm, and builds an index for searching the document collection. All three steps in the analysis process are performed offline. After the completion of the analysis process, an e-mail is optionally sent to the user indicating that the query is complete. The e-mail indicates the number of documents and clusters retrieved. The computation of the similarity matrix and the clustering algorithm are described below. A public domain search engine, Glimpse [Manber 93], is used to search for keywords within the document text. The construction of the index is part of the Glimpse software.

We have approached the clustering problem as an optimization problem. The best solution contains clusters such that the similarity between all pairs of document of a cluster is maximized. A number of Operations Research algorithms are available to solve this type of problem. In section 3.2, we describe the use of the Simulated Annealing algorithm [Johnson 89] to build clusters.

The clustering problem has been solved in prior studies using a number of techniques ([Salton 83], [Sahami 98]). In [Salton 83], two clustering methods are described - a hierarchical grouping method and an iterative partitioning procedure. The approach we describe below is similar to the iterative partitioning where a rough classification is pre-determined and iterative improvements are made. Another method ([Sahami 98]) uses a probabilistic clustering algorithm. Classification decisions are made by knowing the presence or absence of a few terms in a document. The probability a document will be relevant given the presence or absence of the terms is known.

3.1 Similarity Matrix Computation

After every document has been assigned a keyword representation, pairwise similarities between documents can be computed. A cosine similarity measure [Salton 83] defined below is used to compute the similarity between two documents doc_i and doc_j. The keywords used to represent a document i are

defined $term_{ik}$ where $k = 1$ to t. The value of t is the maximum number (100) of keywords used to represent the document. The value of $term_{ik}$ is the number of times the $term_k$ appears in doc_i.

$$cosine(doc_i, doc_j) = \frac{\sum_{k=1}^{t} (term_{ik} \times (term_{jk})}{\sqrt{\sum_{k=1}^{t} (term_{ik})^2 \times \sum_{k=1}^{t} (term_{jk})^2}}$$

All values in the similarity matrix are in the range of 0 and 1. A value of 1 indicates that two documents doc_i and doc_j have identitical content. A value of 0 indicates that there is no similarity between the two documents. The time to compute the similarity matrix is of $O(n^2)$. Therefore, this computation can require a significant amount of time for large n. We developed a parallel implementation on a network of PCs and Sun workstations to evaluate the performance improvement, if the computation of the similarity matrix was distributed over a network of machines.

3.2 Simulated Annealing

The problem of clustering is assumed to be an optimization problem, i.e. there are a number of different solutions to cluster a group of documents such that clusters are 'well-defined'. A cluster is 'well-defined', if it consists of documents which are closely related.

Optimization techniques are well known in Operations Research and simulated annealing is one of the optimization techniques which can be applied to the clustering problem. The local optimization technique starts with a random solution and iteratively improves the solution by alteration until no improvement can be obtained. The problem with this technique is that it is easy to get trapped in a poor, but locally optimal solution. The local optimization algorithm is shown below.

1. Get an initial solution S.
2. While there is an untested neighbor of S, do the following
2.1 Let S' be an untested neighbor of S.
2.2 If cost(S') < cost(S), set $S = S'$.
3. Return S.

Simulated annealing avoids locally optimal solutions by allowing for occasional solutions which are worse than the current solution. The ability of avoiding poor local optima using simulated annealing has been demonstrated for a number of applications [Johnson 89] and this technique can be applied to clustering.

The simulated annealing approach has a physical analogy. It is based on the technique used to build crystals. To grow crystals, the ingredients (crystal melt) are heated to a high temperature and cooled. If the crystal melt is cooled too rapidly, then irregular crystals are formed. When the temperature of the crystal melt is lowered in a gradual manner through a series of levels, it is possible to obtain good crystals. The temperature at each level is held long enough to reach equilibrium at that temperature. By keeping the temperature synchronized with energy of the crystal melt, crystal irregularities are avoided.

The algorithm uses the same principle behind crystal formation. A temperature schedule is used to control the gradual approach to an optimized solution. At each temperature level, a sufficient number of solutions are attempted. Improvements are always accepted. However, solutions which are worse than the current solution are accepted with a probability based on the temperature. At a high temperature, a poor solution is more likely to be accepted than at a lower temperature.

1. Get an initial solution S.
2. Get an initial temperature T.
3. While not yet frozen do the following
3.1 Perform the following loop L times
3.1.1 Pick a random neighbor S' of S.
3.1.2 Let Δ = cost(S') - cost(S)
3.1.3 If ($\Delta \leq 0$) (an improvement) Set $S = S'$
3.1.4 Else Set $S = S'$ with probability $e^{-\Delta T}$
3.2 Set $T = rT$ (reduce the temperature)

4. Return S.

While the simulated annealing approach is easy to understand, the implementation problems are the choice of parameters. There is no single set of parameters that can be applied to all optimization problems and therefore the parameters used for the solution must be customized for the problem.

An initial solution S, for clustering is a random grouping of documents. The documents within clusters are randomly assigned using an exponential distribution. The clusters consists of few large clusters, some medium sized clusters, and many small clusters. The size of clusters depends on the number of documents and is pre-determined before the start of the simulated annealing algorithm.

The parameters which must be defined are - T, r, and L. The two parameters, T and r, prescribe the annealing schedule. The initial value for the temperature, T must be based on the value of Δ. We have used an initial value of 50 for the temperature, T and a value of 10000 for L. After every 100 iterations, the temperature was reduced using the formula below.

$$T = \frac{5.0}{log(\lfloor(\frac{iter}{100.0} + 2.0)\rfloor)}$$

where *iter* is the iteration number. At every iteration, two documents i and j from two different clusters were swapped. The cost of the solution S, prior to the swap was computed by adding the similarities of all documents in the original clusters for documents i and j. The cost of the solution S', after the swap was computed by adding the similarities of all documents in the altered clusters for documents i and j. The value of Δ was the difference between cost(S) and cost(S').

From our experiments, we found that a single run of the simulated annealing algorithm did not give near optimal solutions in ***all*** cases. Therefore, we ran the same algorithm 10 times with 10 different initial solutions. The best of the 10 solutions was selected. We found this approach better than running the algorithm for a larger number of iterations.

3.3 Clustering Noisy Data

When we viewed the results from the simulated annealing algorithm, we came across several poor clusters. At first, we assumed the algorithm was at fault. However, later we concluded that the input to the algorithm contained a broad range of documents and the algorithm was attempting to optimize the classification of a collection of documents which could not be easily grouped. Therefore, some poor choices were made to include documents in clusters such that the collective similarity within all groups could be maximized.

For example, a query for 'knowledge management' to 3 search engines - Altavista, WebCrawler, and Lycos with a limit of 100 documents per search engine, generated a set of 300 URLs with 54 dead or duplicate links. Of the remaining 246 URLs, 28 contained the same text information but were located at different URLs. Another 46 URLs did not have a similarity greater than 0.2 with any of the URLs retrieved. Other queries may have different percentages for noisy documents. Only 172 out of 300 URLs could be clustered for this query. However, this example illustrates the problem of clustering such data.

We took several steps to improve the clustering performance. Instead of using the frequency of the term within the document alone to compute the keyword weight, we used an inverse document frequency weight. The weight for a keyword within a document was based on the number of documents in which the keyword appeared. If a keyword appeared in a number of documents of the collection, then it was weighted lower than a keyword which appeared less frequently in the document collection. We used the following formula [Salton 83] to calculate the weight of a keyword. The weight for term k in document i is defined as

$$weight_{ik} = freq_{ik} \times (log_2(n) - log_2(docfreq_k) + 1)$$

where $freq_{ik}$ is the number of times the term k appears in document i, n is the number of documents in the collection, and $docfreq_k$ is the number of documents in which the term k appears at least once. This weighting scheme improved the discrimination of groups of documents. The weights were normalized per document before being processed by the clustering algorithm.

Another modification we made was the removal of duplicate and irrelevant documents. Duplicate documents were identified by searching the similarity matrix for two distinct documents with a similarity

of 1.0. Irrelevant documents were removed by comparing the similarities of all documents and evaluating against a threshold (0.2). If a document did not have a similarity greater than the threshold with at least one document in the collection, it was deemed irrelevant. The duplicate and irrelevant documents were set aside in a miscellaneous cluster not used by the clustering algorithm.

The simulated annealing algorithm was run on the remaining documents in the collection. Following the execution of the simulated annealing algorithm, we tested each cluster for cohesion. If a document within a cluster did not have a similarity greater than the threshold with at least $\frac{1}{2}$ of the documents in the cluster, then it was placed in the miscellaneous cluster. The evaluation was performed for all clusters generated by the simulated annealing algorithm. Any singleton clusters after this step were also grouped in the miscellaneous cluster. After this step, we had a small collection of 'reasonable' clusters along with a large miscellaneous cluster.

Since many documents were placed in the miscellaneous cluster, we decided to run another clustering algorithm described below *only* for the documents in the miscellaneous cluster.

1. Scan the miscellaneous cluster and build all unique pairs of documents where every pair of documents has a similarity > threshold.

1.1 Make new clusters from the pairs of documents.

2. Set complete to false

3. While not complete do

3.1 Set complete to true

3.2 For every new cluster, find documents left in the miscellaneous cluster which have a similarity greater than the threshold with at least half the documents in the cluster.

3.2.1 If any documents were found, then set complete to false and add the document to the cluster.

3.3 Compare all unique pairs of new clusters and check if at least half of the documents in a cluster have a similarity greater than threshold with all documents in another cluster.

3.3.1 If so, then collapse the two clusters into a single cluster and set complete to false.

4. Return the smaller miscellaneous cluster and other new clusters.

In the first step of the clustering algorithm, we paired documents from the miscellaneous cluster. All unique pairs of documents with a similarity greater than the threshold were identified. A set of new clusters were created from the unique pairs of documents in addition to the existing miscellaneous cluster.

In the following steps, the new clusters were modified by adding new documents or merging with other new clusters. A document from the miscellaneous cluster was added to a new cluster, if it had similarities greater than the threshold with at least $\frac{1}{2}$ of the documents of the new cluster. We noticed an order bias when using the first-fit approach to match a document a cluster. So, we have used the best-fit approach for matching documents and clusters. In the best-fit approach, a document from the miscellaneous cluster is compared against all pair clusters and the cluster with the highest similarity is used. This avoids any order bias and should result in near optimal clusters.

Two clusters were merged, if all documents of one cluster had similarities greater than the threshold with at least $\frac{1}{2}$ of the documents in the other cluster. During the merge, we noticed an order bias which created large clusters near the top of the list of clusters. To avoid the order bias, we paired clusters in alternate orders. The pairing of clusters was performed alternately in forward and backward orders. The steps above were repeated in a loop until no more improvements could be made to the clusters.

The final set of clusters were a combination of the clusters produced by simulated annealing and the clustering algorithm applied to the miscellaneous cluster. For each cluster generated by the algorithm, we examined the similarity values between pairs of documents within the cluster. We verified that at least $\frac{1}{2}$ of the documents had a similarity greater than the threshold with all documents. The exception to this condition was the miscellaneous cluster.

3.3.1 Results

We first tested our algorithm against a test document collection to verify that the clustering algorithm was working. In this test, we found documents with the highest similarity in the collection for all documents. This information was available from the similarity matrix. Next, we computed the highest

similarity for every document in a cluster to a document in the same cluster. The difference Δ, between these two similarities was computed. If the value of Δ was large for many documents, then our clustering algorithm was not accurate. If the value of Δ was 0, then it implied that the document with highest match in the collection was also in the same cluster which validates the function of the clustering algorithm.

In this experiment, we ran the clustering algorithm against a collection of 246 Internet documents. 28 documents out of the 246 documents were found to be duplicate documents and were excluded from the clustering process. Another 83 out of the remaining 218 documents were found to be in the miscellaneous cluster. The following is a histogram for different values of Δ for 135 documents *not* in the miscellaneous cluster.

Table 1. Histogram values for Delta

Δ Range	Number of Documents
0.00 - 0.00	91
0.01 - 0.10	24
0.11 - 0.20	11
0.21 - 0.30	6
0.31 - 0.40	2
0.41 - 0.50	1
0.51 - 0.60	0

Most of the documents in clusters are with the document of highest similarity in the collection. A few documents did not group in the same cluster where the document of highest similarity resided. A possible explanation for this occurrence maybe that the two documents were put in separate clusters because one of the documents may have had a stronger relationship with other documents in the cluster. We ran our experiment against a number of queries to verify that our algorithm was not data sensitive. In all cases, over 75% of the documents in clusters were included with a neighbor document having a Δ less than 0.2.

4 Conclusions

We have developed a number of tools which can be used to search the web. Our software can be used to retrieve documents offline and schedule periodic retrievals of new documents. Following the retrieval of documents, the clustering algorithm we developed filters the document collection and groups the remaining documents. We have adapted our clustering algorithm to handle 'noisy' data from the web. Duplicate URLs and documents are eliminated.

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WebOrama: A Web Based System for Ordered Asynchronous Multimedia Annotations

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Abstract: Asynchronous text-based communication technology has long been established as having value in supporting the collaborative distance learning process. However, in cases where learners seek to acquire skills applicable in real-world working context, this kind of technology proves to be insufficient, in the sense that it makes only some forms of exchange about working practices possible. Asynchronous multimedia communication technology seems both suitable and sufficient for supporting such a process. The project 'SHARP' aspires to produce pedagogical and organisational guidelines for the use of asynchronous multimedia conferencing, both within a community of practitioners that exchange experience and discuss on a common working practice, as well as with learners who are acquiring complex skills. WebOrama is a prototype Web-based system that is being developed for use within 'SHARP' and especially for the support of coordinated, asynchronous multimedia discussions, which will emanate from a video representation of industry's best practice. It utilises an innovative scheme for dynamic filtering, in order to provide an adaptive and customisable representation of content, personalised for a particular user-group perspective. The issues encountered in the design of WebOrama, as well as the implementation approach adopted, are presented in this paper.

1. Introduction

In recent years, higher education worldwide has been experiencing an unprecedented rate of change due to the great and unpredictable impact of technology [Ford et al. 1996]. Indeed, the development of new information and communication technologies (ICT) has placed the educational establishment at a juncture parallel to the fifteenth century academy shortly after Gutemberg's revolution! The Academy is given the chance, through the use of ICT, to incorporate new teaching and learning methods, in order to shift the learning model away from lecture-centred instruction and adopt more efficient, learner-centred models.

Asynchronous computer mediated conferencing, and especially asynchronous text-based conferencing, has been proved effective in supporting the collaborative distance learning process, due to the fact that they offer flexibility in the use of time as well as space [Romiszowski 1990], [Reinhardt 1995]. However, this is the case only when what is being learned is 'textbook' knowledge. Text has its virtues, but it is not good for all purposes: almost ten years of experience with this approach reveal that it can be quite hard to begin and sustain a discussion about specific working practices if the medium of exchange has to be text. When it comes to the learning of skills, especially the complex skills that are embedded in real-world working practices, the support offered by this kind of technology proves to be insufficient, in the sense that it makes only some forms of exchange about working practices possible. Asynchronous multimedia conferencing (AMC) is a useful way of

supporting the acquisition of such skills and real world knowledge.

SHARP (Shareable Representations of Practice: pedagogy for asynchronous multimedia conferencing) is a European partnership project in the Open and Distance Learning (ODL) sector of SOCRATES [European Commission 1995], that aims to identify and disseminate pedagogical and organisational guidelines for the use of asynchronous multimedia conferencing, both within a community of practitioners that exchange experience, knowledge and discuss on a common working practice, as well as with learners who are acquiring complex skills [SHARP team 1997].

The main question for the SHARP project is how we can help students, teachers and practitioners make best use of AMC, so that the key working practices, techniques, skills and operational knowledge within their community of practice can be shared, learned, discussed, applied and improved.

The use of AMC can help because it supports: (i) the creation of vivid, sharable representations of working practices (e.g. concise digitised video demonstrations and explanations by experienced practitioners); and (ii) the collaborative 'discussion' and 'critique' of these representations, over time and anywhere in space, by learners, teachers and other practitioners, using audio, video and/or textual 'annotations' on a digitised video resource.

In effect, learners, teachers and practitioners collaborate in constructing a communal hypermedia resource whose content focuses on a set of real-world working practices. Both the process of constructing the resource and the end product itself, are important in promoting everyone's learning.

Various approaches can be followed for the implementation of systems that support AMC. In fact, a few such systems exist today, but they require proprietary hardware and software platforms and are generally not suitable for the specific needs of SHARP. On this basis, the Software Engineering Laboratory of the Computer Science Division, at the National Technical University of Athens (NTUA), being responsible within SHARP for identifying the requirements for the user trials and providing a common infrastructure to the rest of the partners, set forth the development of a system that would cover the specific needs of SHAPR. The approach that the development team chose, was the use and augmentation of existing components and standards, in order to create an integrated system that will provide the required functionality. The result of this undertaking is WebOrama: a Web-based system for ordered asynchronous multimedia annotations.

The WebOrama system is presented in the following sections of this paper. More specifically, in section 2, the functionality of WebOrama is outlined, whereas in section 3 its system architecture is presented. The issues encountered throughout the prototype implementation of WebOrama are highlighted in section 4. In order to provide a clearer understanding of the client-server approach, an interaction scenario is described in section 5. Finally, section 6 presents some concluding remarks and considerations about future work.

2. The WebOrama system

The WebOrama system will be used by all partners of the SHARP project as a common infrastructure for conducting the user trials. The use of WebOrama, throughout the SHARP project, will help the partners decide how well different components of AMC support different learning activities and how existing technology can be utilised and improved in order to help users of AMC derive greater benefits from their experience.

More specifically, WebOrama will serve as an integrated system that will facilitate the exchange of representations of working practices and the creation, management and presentation of asynchronous multimedia annotations on those working practices In order to do so, it will facilitate the creation of an audio-visual representation of a working practice by an expert practitioner, which will serve as base material for an asynchronous, multimedia discussion. Furthermore, the system will provide a means for exchange and review of the base material and the capture and hyperlinking of multimedia annotations to this material.

One of the most innovative concepts of WebOrama is that of *ordered annotations* [Fig. 1]. This concept stems from the basic idea that the use of the system can be conceptualised as a stepwise process. At the first step, the creators of the audio-visual representation will add annotations that further elaborate on their working practice, reflecting on their tacit knowledge. These annotations belong to the 1st order and are part of the representation of the working practice together with the audio-visual material. The 2nd order annotations are those made by other practitioners that, after reviewing the representation of their fellow's working practice, will comment, argue, discuss, etc., either directly on a specific moment or period of the video-clip or on a 1st order annotation.. Then the same base material can be used within a class of learners, in order to get insight in the represented working practice, as well as review the other practitioners' annotations. The learners, of course, can themselves make comments, questions, etc., on this material, which all belong to the 3rd order of annotations. It is important to note that this ordering scheme serves as a means for filtering of what information (set of

annotations) is presented to each user-group. In this way, even if the same base representation is used at the same time by both a group of practitioners and a class of learners, interference or degradation of service is impossible for either of these user-groups. However, while it is important to separate contributions to a discussion within each group, it might be some times equally necessary to attract attention to a contribution of one group to the members of another group. This is achieved through a *transclusion mechanism*, thoroughly described in [Bieber et al. 1997]. Using this mechanism, the coordinator of the discussion of each user group can include an annotation in a different order-set to the one it originally appeared in. This mechanism can also be utilised to facilitate reusability of an existing set of annotations: a teacher, for example, can define a new order for her class and, transcluding all the relevant contributions from other order-sets, offer an exciting educational resource to her students.

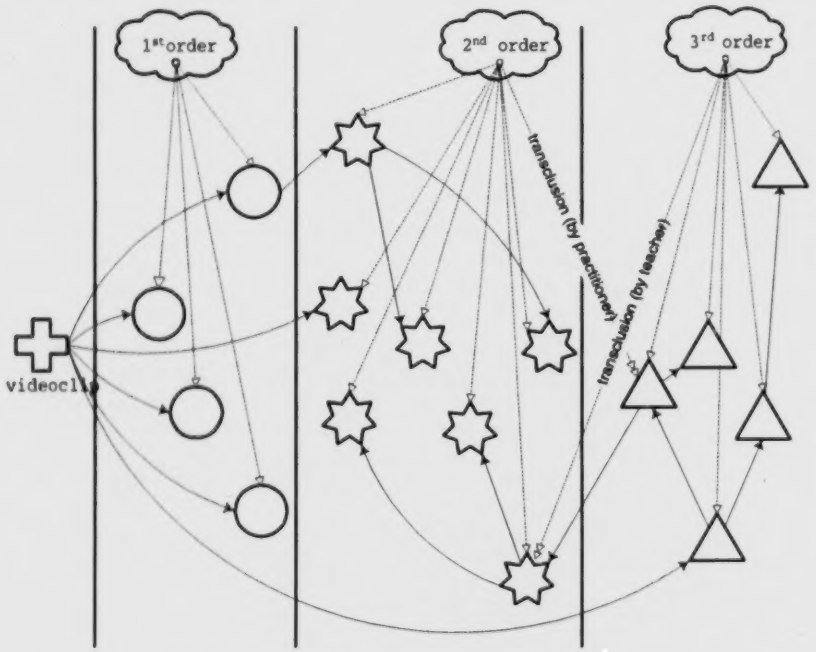

Figure 1: Ordered annotations of WebOrama

3. System architecture

WebOrama was designed for scalability. Special attention was given to the number of users, as well as to the number of "classes" (discrete groups of practitioners or learners), that it will be able to support. One of the most important issues is the ability of the system to present only the information relevant to each user. This is especially critical in situations where the user base grows very large [La Liberte 1994], or different classes of users have simultaneous access to the same base material. WebOrama was also designed for flexibility and ease-of-use: it is a Web-based system in the sense that all its functionality is accessible from an ordinary Web browser. At a physical level, WebOrama is a distributed system and uses the three-tier, client-server model [Sinha 1992]:

- On the *data tier*, there is an annotation server and several media servers, the first holding the system's database, while the latter used as a repository of multimedia material. Physical separation of the annotation server and the media servers greatly enhances the efficiency and responsiveness of the system, while at the same time does not impose design and implementation complexity. The base audio-visual representations of working practices, as well as the content of multimedia annotations, are stored in media servers, that are in fact common Web servers with streaming multimedia capabilities, close to the users' location. On the other hand, identification information for each annotation is stored centrally on the

annotation server, which can be a common ODBC-compliant database server. The annotation server is also responsible for keeping track of user's authentication information and usage history.

- The *application tier* secures that the distribution of services within the data tier is transparent to the end-user of the system. In fact, it contains two distinct components that act as an interface between the data and the presentation tier. The first of these components deals with the communication with the annotation server, whereas the second deals with the communication with the media servers.
- Finally, the *presentation tier* contains the user interface component of the system, and is totally implemented and executed within a Java enabled Web browser (such as the latest versions of Netscape Navigator and Microsoft Internet Explorer). *Special* emphasis has been put on the design and implementation of the user interface, so that it does not hinder the results of the SHARP project by its inappropriateness in any way. It is standard and uniform, facilitating the creation and management of multimedia annotations, as well as the review of existing ones, in a productive and user-friendly way.

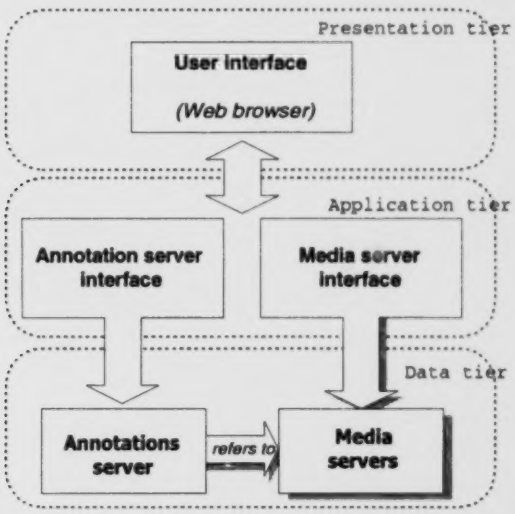

Figure 2: WebOrama's three-tier architecture

4. Implementation issues

As described in the previous section, WebOrama is a three-tier, client-server application, composed of several distinct components. This approach has been chosen as being the most appropriate for the implementation of the desired user-annotation interaction model. Each annotation is stored in the annotation server as a record with the following fields: `CREATOR_ID`, which refers to the creator of the annotation in the users record-set; `DATE`, `SUBJECT`, and `TYPE` that are used to shortly describe the annotation; `CLASS_ID` that refers to the record-set of classes for defining the class in which the annotation belongs to; `ORDER` that represents the role of its creator (order 0 if it belongs to the creator of the base representation of practice, 1 if it belongs to other practitioners, and 2 if it belongs to a student); `ACL` that defines the availability of the annotation to members of other classes; `URL` and `REF_POINT`, that contain addressing information for referencing its multimedia content in the media servers. The other main record-sets of the annotation database hold information about the users of the system, the available classes, and usage history. The entity relationship diagram of the annotation database is depicted in [Fig. 3].

An important implementation issue was the physical location of execution of the two components of the application-tier. We have chosen to put both these components on the client side in order to take advantage of the communication capabilities of the Web browser and reduce server load [Röscheisen et al. 1995], [Röscheisen et al. 1997]. The browser uses the HTTP protocol and standard multimedia streaming protocols to fetch multimedia content from the media servers and a Java component, based on the JDBC (Java DataBase Connection) programming interface to communicate with the annotation server. Communication with both

servers are made in parallel in order to increase performance and keep response times as short as possible.

Another issue encountered during the implementation, was that of embedding a video resource in an HTML page, since until recently, such a task would only be possible with the use of proprietary plug-ins. Existing media players for desktop computers are heavily dependent on native code for computationally intensive tasks like decompression and rendering. However, the newly released Java Media Framework (JMF) 1.0 makes handling multimedia resources possible within any Java applet. The JMF specification defines application-programming interfaces (APIs) that provide a platform-neutral framework for displaying time-based media. JMF provides an abstraction that hides implementation details from the developer. JMF is in fact a set of three APIs (being co-defined by Sun, Silicon Graphics, and Intel), the Media Player API, the Capture API and the Conferencing API. Only the first one is currently available for use, while the others' release date is still to be determined [Javasoft 1997].

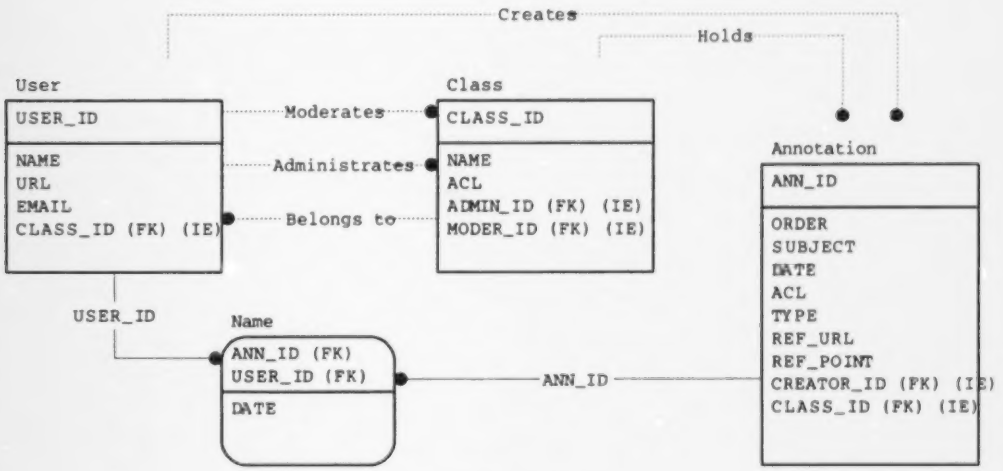

Figure 3: Annotation database ERD

5. Client-server interaction scenario

In order to provide a clearer view of the WebOrama system, in the following paragraphs we discuss the client-server interaction and flow of control within a sample usage scenario. In this scenario a typical user, Foe, enters WebOrama, joins a class and views existing annotations. Although this is only a small set of the functions supported by the system, it is quite complete for purposes of describing the way WebOrama's components communicate with each other in response to the user input.

- *Entering the WebOrama system*: When entering the system, Foe has to go through the user authentication process. The client makes a request to the annotation server in order to retrieve the profile information for Foe. This information is essential, as it provides a way of filtering annotations to suit Foe's specific needs and preferences.
- *Joining a class*: The profile returned to the client by the annotation server also contains accessibility information, as each user is usually not permitted access to all available classes. Based on this information, Foe is presented with a list of the classes she can join. After joining a class, she is presented with a list of all available 'topics of discussion' with visual indication on the 'depth' of each discussion. Foe selects one topic and the client proceeds with two requests. The first request, addressed to a media server, is for the audio-visual representation of a working practice that serves as the base of the specific discussion topic. The second request, addressed to the annotation server, is for the set of annotations within the specific topic. It is important to note that the client uses the profile information, as well as the current selection of preferences that Foe has made (with the use of visual controls), in order to query only for relevant annotations. Another important issue is that the client proceeds with these two requests in parallel, in order to improve responsiveness.
- *Viewing annotations*: Foe, while viewing the base material, has visual indication of the corresponding

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annotations. If she chooses to view one, the client makes a request to the suitable media server using the HTTP protocol or streaming multimedia protocols (through the JMF) in order to fetch and display the content of the annotation.

6. Concluding remarks and future work

Collaborative learning has long been established as having value in education. However, it was the widespread use of the World Wide Web that has made feasible many new forms of collaborative learning activities; forms, that take advantage of the capacity to integrate communication with information access and organisation within a commonly accessible hyperlinked environment [Collis 1996], [Khan 1997]. Additionally, the fact that WWW-based environments can be accessed independent of time and geographic distance, has brought a new wave of possibilities for collaborative distance learning and a heightened frequency of participation in such possibilities to higher education [Collis et al. 1997]. However, no proof for the pedagogical effectiveness of such approaches exist as for today. Research on this field has to focus on how to design, build, evaluate and validate systems that will exploit the great potentiality of these technologies in combination with current pedagogical trends [Rossner et al. 1995]. WebOrama is certainly a step towards this direction.

WebOrama is still an experimental system and there are not adequate results from its use, in order to attempt an evaluation. This will be done in the future. Nevertheless, our understanding of the technology of Computer Mediated Conferencing (CMC) on one hand, and the experience gathered by its use for supporting learning activities, on the other, are, we believe, good credentials for the work that has been done and for the one to follow. Though it is in an early stage of development, it is expected to help the SHARP team evaluate the pedagogical effectiveness of AMC and produce significant contributions and valuable guidelines about the pedagogical and other organisational issues involved with the use of AMC for the sharing of working practices within a community of practitioners and learners. Methods of ergonomic analysis will be applied for the evaluation of WebOrama. Only then, will we be able to decide on the effectiveness of the different components of AMC in supporting different learning activities, judge how the technology might be improved, and thus identify guidelines and protocols which will help users of AMC derive greater benefits from their experience.

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Steps To Distance Learning: Enabling Web-Based Project Development And Collaboration

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Abstract: Increasing technology integration in schools is a national priority. A process for the development of Web-based projects and support in enabling collaboration with other working teachers has been evolved to provide the means for the "integration of technology into existing programs" [The President's Educational Technology Initiative 1996]. The process involves stages of increasing difficulty and collaboration in a constructivist model [Sparks and Hirsch, 1997]. Goals include ownership, collegiality and movement toward distance learning. A three-day turnkey course, *Teaching with the Web*, provides teachers with basic Internet training and enables development of a collaborative Web-based project. A project template facilitates the relationship of curriculum content and standards to assessment. Wider collaboration is emphasized in a second stage: a stipended Project Facilitator develops a full multi-disciplinary project with searchable content standards, then trains teachers and moderates a discussion board for their support. The third stage is total online collaboration.

Introduction

Federal granting programs [US Dept. of Education, Office of Technology] such as the Technology Literacy Challenge Fund, the Technology Innovation Challenge Grants and Goals 2000 as well as state programs such as New Jersey's Department of Education's Office of Educational Technology's [NJ Dept. of Education, Office of Technology] Educational Technology Training Centers are encouraging training and support of teachers as well as the purchase of equipment. Equipment and the wiring of schools is also supported via The Telecommunications Act of 1996 Universal Service Fund [Universal Service] and, for instance, New Jersey's Distance Learning Network Aid "to provide districts with distance learning network aid on a per pupil basis to assist the major investments necessary to access broad electronic communities over distance" [Distance Learning Network Aid].

Thus the teacher today is under increasing pressure to become involved with technology-integrated learning as well as to work collaboratively over the Internet. The *Bergen Educational Technology Training Center* (Bergen ETTC: *http://www.bergen.org/ETTC*) is one of 21 ETTCs in New Jersey to support technology planning and the training of teachers to integrate technology in the curriculum. Bergen ETTC has focused on a methodical hands-on introduction to Web-based learning that provides ownership and enables collegiality. In keeping with adult learning theory [e.g. Nebraska Institute for the Study of Adult Literacy] it is important that the teachers be able to develop or change activities for use in their own classroom.

The Process

A three-day turnkey course, *Teaching with the Web* [Teaching with the Web], is the first step in the process, and consists of (a) Day 1: Internet I – the browser, searching, bookmarks and their organization, and email; (b) Day 2: The Teacher Page [Teacher Page] examples of projects and activities on the Internet, the use of the Project Template to develop a collaborative project which is interdisciplinary and which facilitates the relationship of content and process standards to a constructive assessment, a focused search for relevant bookmarks and organization of the bookmarks; (c) Day 3: saving the bookmarks as a file in Netscape Gold or Communicator, editing this page, saving and adding images, adding more links, and using tables to aid in the Page design. School districts are encouraged to send groups of teachers so that they can collaborate on the development of the projects, support one another's learning, and ultimately aid one another in turnkey training in their districts. Day 2 is critical in that it involves discussions about technological support for differing learners and of teaching as facilitation. It also begins a collaborative creative process as the teachers begin to form groups of 2-4 persons for the development of a project. The course itself is a model which demonstrates how to encourage groups to experience similar processes using different content (in this case, the project itself) but in ways that are dependent on their learning needs and prior knowledge. The teachers save the projects to disc; projects are also captured for inclusion on the Teacher Projects Page ["Teaching with the Web" - Teacher Projects] on the Bergen ETTC Site.

The second stage in moving toward distance learning involves the Project Facilitator and collaborators who may be in other schools, at a distance. A turnkey trainer may apply for the position of Project Facilitator, for which there is a stipend. The Project Facilitator, over several months, develops a full multi-disciplinary project, using the Bergen ETTC's project template. It is expected that the project shall include content and workplace readiness standards. Each project Site has at least three Pages: an Overview, Group Research and Core Curriculum Standards. Some projects also may have a Social Action and/or Sample Project (if the project has been run) Pages. The projects are added to the Project Page [Projects]. Project Page projects are searchable for the content and workplace readiness standards using a downloaded engine. After developing the Web Site, the Project Facilitator seeks 8-10 colleagues in various districts, and trains them on the project at a local school or at Bergen ETTC. During the implementation of the preparation and the teaching of the project (at several schools), the collaborators and the Facilitator communicate via a Discussion Board associated with the project.

Future Plans: the Third Step

The third step in this process involves the establishment of online courses for both professional development and for classroom support or inclusion. Students and/or teachers will routinely participate in ways that are already readily available on the Web (especially for pre-high school level). A goal of the steps above is to make this last step easier to accomplish, to make it more routine. Another goal is to enable teachers to create their own or to have the confidence to modify projects already online. At present, Bergen ETTC is preparing online courses which may be taken at any time (asynchronously). It is expected that teachers trained as turnkey trainers, Project Facilitators, or collaborators will feel comfortable with 'learning at a distance' both as a student and/or teacher.

Other steps in expanding the scope of distance learning and its ownership by teachers include the provision of rewards, financially and via professional improvement plans (PIPs) To that end, the Bergen ETTC has established continuing education unit (CEU) and graduate credit for teachers, for participation in courses or collaborations. It is expected that these arrangements with regional universities will continue into the online 'distance learning' courses.

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http://www.fcc.gov/ccb/universal_service/welcome.html

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Dynamic Geometry on WWW

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Abstract: The development of dynamic geometry in teaching is arousing the creation of many pedagogical Web sites that cannot take benefit from this technology throughout their pages at the present time. Classical techniques in figures animation on the Web are either too limited, or too difficult to implement. The project Cabri-Java plans in a first time to develop a Java applet allowing to bundle all the advantages of dynamic geometry in active figures. The realization of a complete Java application for creating and manipulating figures is being studied.

1. Dynamic Geometry and Teaching

The development of Dynamic Geometry has been closely related to the development of Direct Manipulation.

Actually dynamic geometry roots probably long time ago when some mathematicians including Clairault (XVIII) or some more recent authors have considered the idea of moving elements of figures in order to illustrate (geometrical) phenomenons and to prove theorems.

Dynamic Geometry with Direct Manipulation is often embodied in computer environments offering to the user - teacher or student - an opportunity to develop intellectual activities based on geometrical knowledge. In other words the user is placed in a microworld, in the sense of what has been called by Seymour Papert when writing his most famous book Mindstorms, Children, Computers, and Powerful Ideas [Papert 1980] (Cf the Logo orientation). In contrast to Logo in a microworld centered on geometry, as implemented in Cabri or Geometer's Sketchpad, the mathematical content to be taught plays a key role. Through Direct Manipulation the student can construct his own sophisticated construction, mobilizing for that more or less complex geometrical knowledge, and he can interact directly with the representations of the theoretical geometrical objects. Key features of such Dynamic Geometry environments are

- a mathematically solid base of the implemented geometry
- a user's friendly Man-Machine interface to allow for immediate familiarity with a substantial part of the environment
- a fast feedback of the system to allow the user to have control of the behavior of the objects (s)he has constructed.

For many years, works [Schneiderman 1983, Laborde 1996, Laborde Strasser 1990, Schumann 1993] have shown the importance of direct engagement of the learner using construction software for manipulating of geometrical objects. . Research made around the software Cabri-geometry [Cabri site] underlines the preponderant role of student's personal investment. This frees his mind from the difficulties he is faced with when constructing geometrical objects that can be often difficult to draw, and he can freely analyze problems that are posed for him in an active and dynamic way. Cabri [figure 1] , as multilingual software available on Macintosh or PC platforms, but also on pocket calculators [TI site] has today exceeded the million of copies sold around the world and has aroused the creation of many collaborative groups such as "Cabri clubs". Its use in classroom, but also in auto-learning out of school time has been so much greatly developed so that hundreds of users meet together during Summer Institutes organized about this software.

This tool for dynamic geometry is also used in a fruitful manner in other areas where geometry serves as mathematical support for scientific modeling in optics, electronics, mechanics, astronomy...

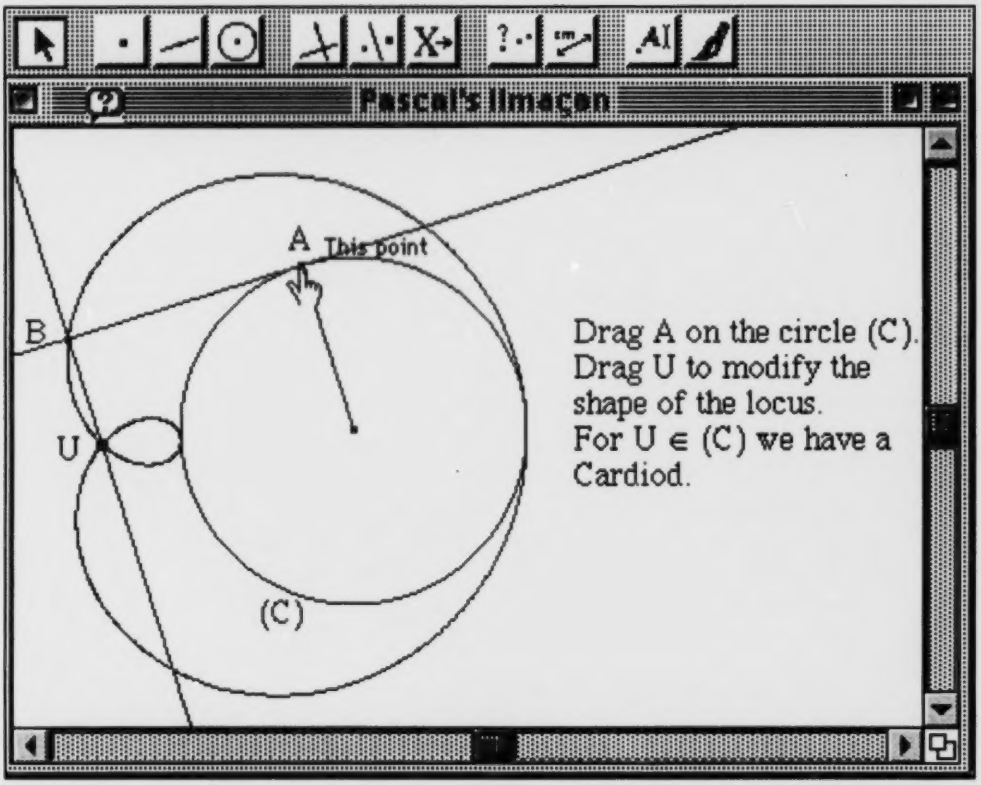

Figure 1: Cabri-geometry software

That kind of tools turns out to be also well suited in contexts involving disabled students being in difficulties, either at the school level (personalized support), or at the medical level (TéléCabri project [TéléCabri site], a distance learning project for hospitalized children).

2. Geometry on WWW

From its beginning, the Web appeared as an indispensable tool to allow in the first place for a better collaboration between teachers. They were able to exchange their courses, discuss on concrete documents about best tools for teaching. Mailing lists have been created, many Webs sites have extended through the world; some of them include particularly dynamic geometry.

Other teaching experiences where the main center of interest is the creation of Web sites by pupils themselves have spread out recently. In this framework, pupils become to be actors of their learning, to communicate with others classes throughout the world, and to share their growing knowledge. Faced with this new situation, some students who were exposed to a traditional teaching feel comfortable in a context where personal initiative is more requested. Generous ideas of youth to help other pupils who perform badly at school or are experiencing momentary difficulties (for example hospitalized) often motivate children to give their best to put exercises and comments on the Web, or edutainment activities or corrected versions of homework (see for example this site of a college from Grenoble[Cabri site].

How to manage then to gather benefits of dynamic geometry and the Web?

The first solution consists in describing in phrasing of the problem and by screen copies, the exercises that have to be done with the help of software as Cabri-geometry. The major disadvantage of this method is a loss of time caused by the installation of geometrical elements of the figure before being able to really tackle the problem posed. The play side of the learning process through the Web is then totally erased.

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A second possibility is to allow the direct transfer of files coming from the dynamic geometry software from the Web server. This solution needs the definition of a MIME type for the transfer of files, the configuration often manual of the browsers as well as the preliminary existence of the software Cabri-geometry on the client's computer. The client will have to be able thus to launch the software at the same time that the browser, as an application helper. If all these conditions are gathered, the user will be able thus to take full advantage of the capacities of the software, but his work will not be directly integrated in the page Web where the figure will have been unloaded. It will have then to make back and forth between the software and the browser to follow for example the instructions given in the Web page.

These two methods have therefore the disadvantages to require several preliminaries for the use of dynamic geometry through the Web:

- to have the software Cabri-geometry, which does not run outside the compatible systems DOS, Windows or MacOS.
- to have its browser configured in order to launch Cabri directly from the downloaded figures or macros.
- to have an enough powerful computer to allow the launching of the two softwares concurrently: the browser and the dynamic geometry software.

Until a more adapted solution is found, some sites use nevertheless this method as for example the site abraCAdaBRI [abraCAdaBRI site] available on the server of the Cabri project. But all the webmasters of these sites request to have the possibility to place animated geometry figures directly in their Web pages.

3. Classical Supports for Animations

Let's study the ways to put animations done with a dynamic geometry software directly in pages of a Web site.

QuickTime or AVI, which are animations people use mostly, have formats that can be useful to code animated sequences captured from a direct use of the software. But despite these formats are taking up a growing part on various platforms, some incompatibilities with some systems are remaining. Moreover the size of corresponding produced animations remains often too important for slow connections.

To overcome the impact of this difficulty a solution can consist in producing graphic animations in the format of animated Gifs, directly supported by all recent browsers. Today, many tools allow creating such animations by a sequence of files taken from "screen snapshots". By limiting the number of colors (a coding on 4 or 5 bits is often enough), the size of the animated files is often smaller than the size of corresponding QuickTime or AVI files. The official Cabri site shows some simple examples of animations that can be produced.

These animations have nevertheless a major defect: they are only " pictures " of an animated sequence and in front of them pupils remain passive. Any direct commitment disappears and with it one of the essential contributions to the Sciences of Education of these last years.

Then, how to allow to create a real interactivity between pupil and animated picture on the Web?

The first solution is to use one of the most well-known softwares in animation like Macromedia Shockwave to create animated sequences based on a real interaction scenario; the free use of the Shockwave plugin allows then the integration of animation into Web pages. It is this way, which has been used in some pages of the site AbraCadaBRI [abraCAdaBRI site].

This method involves several major disadvantages:

- the cost of the software Director making Shockwave animations often too expensive for school budgets.
- the necessary time to create an animation (the author of the animation shown in the above example, claims he has needed a complete day to create it).
- the interactivity too heavily controlled by the system reducing the freedom to explore and discover new solutions.
- the additional memory size asked to the browser when loading the plug-in which often causes a lockout of this plug-in on limited configurations.

An other solution would be to realize a specific plugin allowing to recreate the Cabri environment for figures integrated into the Web pages. Writing this plugin with a native code presents pros and cons. On the

one hand, it is the best way to put Cabri on the Web, but on the other hand, it is necessary to rewrite the plugin for each existent or future system. This last point added to the problem of the preliminary installation inherent in plugins led us to turn down this possibility.

4. Cabri-java

The solution finally chosen to put active figures on the Web was to use the language object Java. This choice has been taken for several reasons:

- the Java multiplatform support through virtual machines for each architecture,
- the increasingly close integration of Web and Java in recent browsers,
- the object programming well adapted for realizing animation of geometrical structured objects.

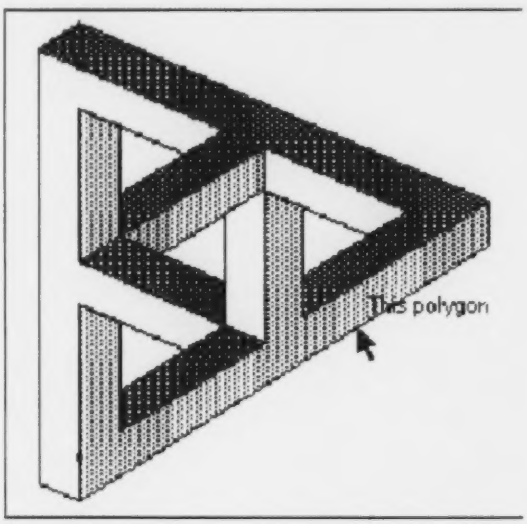

Figure 2 : Cabri-Java applet

The project Cabri-Java in its current phase devotes in a first time to writing an applet allowing to animate a dynamic geometry figure by resuming as best as possible ergonomics of the software Cabri. This is sometimes difficult to do because of gaps contained in first tools of Java development (JDK 1.0.2). By example, the only standard classes known by browsers do not propose direct possibility to change the mouse cursor's form in an applet, neither to display pop-up menu in the applet zone itself. At the graph level, the aspect for dotted or bold lines is not planned, unless to program it oneself, what would not be efficient compared with the selection of native methods on each architecture. All these gaps are nevertheless on the way to being filled by JDK 1.2 and the new standard Java 2D API.

Once Java has been chosen, it remains to determine the way to transmit to the applet the numerous parameters allowing to define a geometrical figure even not very complex. A solution could be to describe all objects and their properties with the help of PARAM tags of the applet. This is the way chosen to communicate geometrical data to applet in two other dynamic geometry java projects [JavaSkettchpad site, Joyce 1998] But, on the one hand it is soon very difficult to create manually all these data and on the other hand HTML files would have become then very heavy. The undertaken choice has been to preserve all the files generated by the software Cabri by putting them on the server in order the applet could read them, only one tag PARAM was necessary to indicate the file name and its position on the Web server.

The advantage of this solution is an easy publication, but the disadvantage is that it requires having the software Cabri, what is not a real restriction for webmasters who are developing sites devoted to the use of this software in classroom...

How to do in practice to publish an active figure?

- It is necessary to put on the Web server binary files Java (.class) of the applet or a non-compressed zip archive of these binaries. (One can also reference another server that have the applet binary through the parameter CODEBASE).
- In Web pages, the whole tag describing the applet can be for example:

```
<APPLET CODE="CabriJava.class" WIDTH=600 HEIGHT=400
 ARCHIVE="CabriJava.zip">
<PARAM name = "lang" value = "en">
<PARAM name = "file" value = "figures/College/Star">
</APPLET>
```

The "lang" parameter can for the moment take " fr" values for the French messages and "en" for the English ones.

The "file" parameter indicates the path (here the relative one) of the figure on the server.

- Other decoration parameters have been added like tags for Web page's background :

```
<PARAM name = "background" value = "images/bg.gif">
<PARAM name = "bgcolor" value = "#F0F0A0">
<PARAM name = "border" value = "0">
```

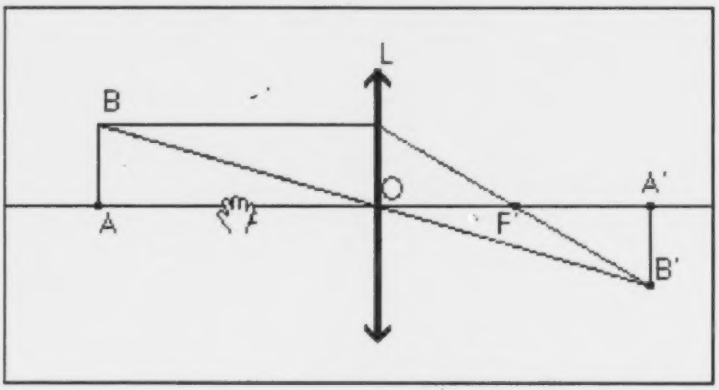

Figure 3: Cabri-Java optical example

In its current preliminary version, the CabriJava applet already allows to put active figures in Web pages, in which the user can drag geometrical objects while preserving the geometrical properties defined in their creation. A demonstration page is available on the Cabri project's server [Kuntz 1998] and allows to better test the possibilities.

Even if all the possibilities of the software Cabri are not yet transcribe in Java (loci, conic...), a first pedagogical use has already been done on the Mathematical Server of La Réunion [Hakenholz 1998]

To the current stage, Cabri-Java suffers from slowness of virtual machines proposed with browsers. But a new generation of VM (virtual machines) is coming, implementing JIT (Just-In-Time) compilation technology, allowing to obtain a feedback really sufficient during objects dragging.

5. Future Work

In parallel with the work consisting in completing the CabriJava applet to integrate in it most of the possibilities offered by the software itself, the project is developing into two ways:

- implementing "a priori" or on action animation aspects: Cabri already allows animating figures on user's action by using the "animation spring" tool [figure 4]. But, it seems also useful to be able to animate figures on the Web immediately from their display without any intervention from the user. In order to specify the drag that should be undertaken, a supplementary parameter of the applet will be able for example to transmit messages to named objects of the figure through a script language already defined in the framework of Cabri-script project for communication between Cabri figures.

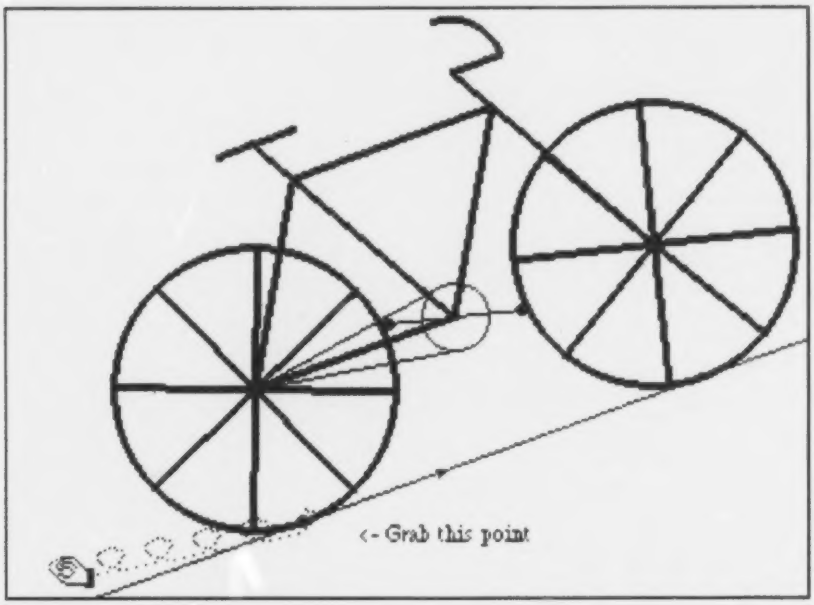

Figure 4 : Cabri-Java real-time animation

- conceiving and realizing a Java application for constructing and manipulating Cabri figures: the equivalent of a multi-platform Cabri. Even if this program will never have the fluidity of Cabri native applications, it will be very helpful to create figures that could be then used by CabriJava applet. An other interest of such application will be to enable a best knowledge of dynamic geometry by allowing a larger distribution of its approach and its use in many active figures throughout Web pages. To develop such an application presenting a same user- interface on all platforms, it is envisaged to use Java Foundations Classes defined by SUN [SUN JFC 1998]

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Automated Organization of Caches Architecture

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1. Introduction

We consider the case of a multi-discipline company distributed in several sites. These sites are linked with a sufficiently dimensioned Intranet which allows a good quality of service. We use caches to increase the comfort of the users for an external connectivity to Internet. These caches are organized so as to cooperate and so to optimize performances. The objective of this proposal is to use the principle of the learning process to direct automatically each user towards the most liable cache which contain his requested page. Furthermore, we describe, according to the same principle, an automatic organization method of cooperating caches architecture. In this context, it is more interesting to use several thematic self dedicated caches instead of a « big central» one. Each dedicated cache will correspond to a specific activity of the company.

2. General Presentation

In this document, the expression « local cache » makes reference to a shared cache which is local to a site and not to a browser. Cooperating caches architectures are now rather spread, figure 1 shows us an example. In such an architecture, the user set up his browser to get connected to the nearest first level cache. This one questions the second level cache when it can not find the requested page in its memory. Finally, if the third level cache does not have the page, it questions directly the distant server. This kind of architecture works with the HTTP for the transport of the main data and the ICP protocol for the communication between caches. It allows better performances than a unique central cache. Afterwards we presents some ideas in order to optimize the performances of cooperating architecture. In our proposal, users will be automatically grouped in several virtual communities of interests. We introduce the dynamic organization principle based on the thematic profile of the cache content. In one word, each user will be directed towards the first level cache that contains data closed to its center of interest. In this condition, the probability to find the requested page (Hit rate) is higher than in the regular architecture. Figure 2 highlights the most dynamic aspect of this configuration.

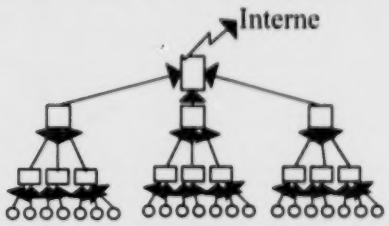

Figure 1 : Regular cooperating architecture

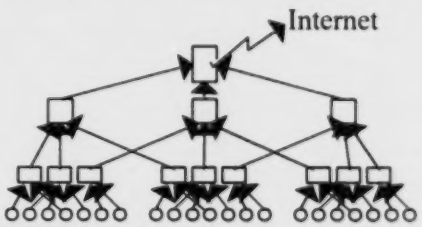

Figure 2 : Dynamic cooperating architecture

This organization is based on the observation and the analysis of the users' connectivity's. Initially, the users are directed towards the nearest first level without other consideration. Likewise, each first level cache is directed towards the nearest second level one. The second phase described below consists in identifying the different users profiles and in categorizing it in a limited group of topics corresponding to the number of the first caches level.

3. Identifying Users' Profile

The analysis of the cache content as well as the caches log files give us precious information about the users' behavior. Indeed, the cache contains pages and all the necessary information which allows to identify the pages

viewed by each user. A specific algebraic model of semantic association [Lancieri 1998] based on neural networks allows a self-extraction of themes corresponding to a set of multimedia documents. Operating this model on the cache content allows to extract the center of interest of the users. In this model, the cache is used as an « implicit filter ». This means that it will only contain, according to its operate mode, data corresponding to the profile of users who are connected. The lexical analysis of the cache content allows to build a semantic network where each neuron represents words. After the learning period, the weight of the links between neurons will be as high as the semantic links between associated words. The algebraic representation of this semantic network allows to extract interesting properties using regular mathematics tools. In this representation, each word is associated to a vector in a global matrix so it is possible to evaluate « semantic distances » by calculating Euclidean distances between vectors. It is also possible by calculating proper vectors of the global matrix in order to bring out the most representative words from the analyzed documents. These words are those to which other words make the most often reference directly or not. We identify these words as themes. It is also possible to extract themes in a sub set of pages only downloaded by a specific user or a delimited group of users. We identify these specific themes such as the users' profile. Since a theme and profiles are represented by vectors, it is convenient to evaluate if two profiles are closed to each other by calculating the Euclidean distance. All the details about this aspect of the paper can be find in a referenced paper.

4. Interconnection between Users and First Level Caches

So, the goal is to group the users who have common interests towards a specific first cache level . As we explained previously, the first step is to identify the users' profile, then to categorize them, and finally to allocate a theme or closed group of themes to each first cache level. It is now necessary to connect dynamically users to their « dedicated » first cache level. This is done through the auto configuration file (.cap) capabilities of the web browser. The principle is to indicates one and for all during the configuration of his browser the path to a server that contains the auto configuration file. This file is a Java script automatically downloaded by the browser which describes the rules of the connection between users and caches. The administrator of the network have the ability to change the content of this file and so the rules of connectivity. In our case, the management of this file is automatically operated by a process that takes into consideration users' profiles. It is indeed important to see that the connectivity rules move during the time because they are based on a learning process which is fundamentally dynamic.

5. Interconnection between Caches

This part describes the automatic configuration of the connection between first and second caches level. The goal was first to determine the profile of each user, we have now to determine the profile of each first level cache. This could be considered superfluous at first because we already allocated themes to these caches. Actually, we have to consider that this allocation was based on an approximate analysis grouping in one component several users. These users have a fluctuating behavior including « noise » (connection without relation with the allocated topic). So, in order to « integrate » the behavior of several users it is necessary to analyze the whole cache content. So, once we have done this for all first level caches, we have to categorize all these first level caches profiles regarding to the amount of second caches level. Finally, all second level caches will be directed towards the unique third level cache.

6. Conclusion

The main idea of this proposal is to automatically identify groups or communities of interests on an Intranet. The organization of caches' architecture according to these groups of interest allows a higher global performance. This ability also allows to envisage other form of services such as the automatic diffusion of information according to the users' profiles or the control of access to documents for example.

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The Study Guides Website: Crossing Linguistic Boundaries

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Abstract: on how the student staff of a university media center translated a website into Russian, Arabic, Chinese, French, German, and Italian using Tango browser and editor. What began as a pilot, experimental project evolved into comprehensive translations of the entire website to facilitate the dissemination of an educational resource across linguistic boundaries. This paper describes the process, as well as surmounting the barriers.

Whether as marketing tool or educational service, delivering information across linguistic boundaries is a necessity made possible by the Internet. The purpose of this presentation is to outline the development of the award-winning Study Guides Website into an international resource. From a pilot project in January 1998, the entire website (53 pages) is now available in Arabic and German, and partially available in Chinese, Russian, Italian, and French.

What began as a linguistic test of Internet capability has now grown to include business websites developed in Japanese, Chinese, and Polish where HTML was developed from text sent from the country of origin via e-mail.

The University of St. Thomas' Learning Center (http://www.iss.stthomas.edu/lc) is the central student computer lab/media center serving about 400,000 client visits with1.3 million pages of print out per year. The supervisor, and its instructional technologist, is Joe Landsberger since 1976. His focus has always been to facilitate learning, adapting technology to serve student needs. As part of this mission he has actively sought out international students and students of color to serve as media consultants.

The Study Guides Website began with Rutgers University's Learning Resource Database initially developed by Bob Nelson, et al in June 1993. It was created in Filemaker Pro on a Macintosh platform. In February 1996 this database was adapted & modified in HTML by Joe Landsberger & Peter Turi, his assistant from Budapest, Hungary in the ISS/Learning Center, University of St. Thomas with permission. All collaboration was done via e-mail. The developed website "Study Guides and Strategies" (http://www.iss.stthomas.edu/studyguides) has been continually revised and edited since then, and accessed more than 90,000 times.

The process of conversion of the text from the Filemaker Pro database format turned out to be the same as when the Foreign Language Development Program began.

1. An HTML template was created in simple text. The text from the database was then copied, and pasted into this code.
2. Editing: while the text was already in a "computerized format", much editing and re-linking was necessary, into an HTML appropriate format. The main menu was drastically revised, as were the texts of the individual pages. At this time they were also standardized since they were written by a number of staff at Rutgers, but not reduced to a common format. Often text was more appropriate to an 8 ½ X 11 inch paper, than to a computer monitor.
3. 53 pages of Study guides went on line September 1997.

For 1997-98, the main page was hit about 48,000 times its first year, and secondary pages were accessed another 48,000. Approximately 1,000 hits/week derive from outside of the University.

Beyond Linguistic Boundaries: The Internet can be viewed as an international information medium. Since the Learning Center has an International student staff, and since extending the opportunity to provide this information was deemed desirable, we researched coding for languages on the Internet, focusing on those where we had students on staff who were native speakers. The Internet Browser and Editor called "Tango", capable of coding in over 100 languages, was used. The decoding was text, as opposed to graphics based, and thus searchable.

The pilot project with student translators and HTML editors took place during the January 1998 Term when it was considerably less busy than the two semesters of Fall and Spring. Student workers learned the basics of HTML, how to copy the source of the Study Guides' Index Page, and pasted it into the Tango Editor. At the same

time we printed the page in English. Student workers then translated and typed the translation directly into the editor, leaving in tact the original HTML of the English page.

The index page was translated by students: Xia-Lian Kou, Chinese; Mario Gramigni, Italian; Vadim Gurevich, Russian; and Ali Alahmed, Arabic. We set up a station within our facility and called it the Foreign Language Development Project. Staff translated as they worked their "desk shifts" since there was lesser demand for their consulting services.

The learning curve was rapid. The index page translations were completed at the end of the first week, when we continued to translate the first sector of nine pages "Study Preparations". Each non-translated sector has a warning that the links were to English web pages.

Care was taken not to translate blindly, but to approach the study guides with cultural sensitivity. it turned out that each language had its own peculiarities and options as regards the HTML. with Chinese, Big 5 traditional was chosen, with Russian, Windows 1251; Arabic Windows 1256, and Italian, the European character set.

After a page was translated, it was imported into the website via MSFrontPage's Explorer. With European translations including Russian, the format was altered and finalized using the Editor. For non-European character sets, editing HTML needed to be via the text editor. Frontpage enabled certain WebBots used in the English version, including dating revisions, adding counters for tracking purposes, and incorporating templates and pages.

For the two non-European languages, Chinese and Arabic, individual pages could not be opened in the foreign Page Editor or the language coding would be corrupted. Recent capabilities in Windows 98 change this.

Downloading webpages in other languages will be discussed in the context of the presentation, including recent developments.

An Education Broker Toolset for Web Course Customization

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Abstract: Within an Electronic Education Market an Electronic Education Mall is defined as a virtual service center to support various transaction processes by providing a technological platform with appropriate value-added services and interfaces for suppliers and customers. In this context, an Education Broker service is of central importance because the quality of the learning process is strongly determined by the quality of the available materials and their configuration to an integrated course according to a pedagogical concept and the respective customers' needs. To support these tasks an Education Broker toolset is introduced which allows to select the 'right' elements out of a set of generally suitable learning modules, to adjust and structure the chosen learning modules to an integrated course in a pedagogically and didactically useful way, to add navigational guides, to provide added values and to deliver the integrated course to allow an intuitive application by the student.

1 A Market-Oriented View on Media-Based Education

Parallel to the technological development an increasing commercialization of education and training can be observed. More and more companies, organizations, and institutions are trying to get their share in the promising media-based education and training market. Supporting the convergence of supply and demand electronically in this context is a true challenge. According to a general definition of the term 'electronic market' [Schmid 1993, 468] the emergence of an electronic market for education and training can be interpreted as a telematic-based marketplace which supports the exchange of goods and services by applying market oriented mechanisms. This market should not only be considered a physical place where supply and demand converge but in particular as a coordination instrument. "The market is not a place, a thing or a collective entity. The market is a process, actuated by the interplay of the actions of the various individuals." [Mises 1949, 258] One can expect that flanking developments in electronic commerce (cf. [Kalakota & Whinston 1996], [Kalakota & Whinston 1997]) will force and shape the establishment of an Electronic Education Market [Hämäläinen, Whinston & Vishik 1996]. Systems supporting the coordination and cooperation tasks within an electronic market have to provide a multitude of services. In addition, standardized interfaces for suppliers and customers are needed.

Internet-based electronic malls are a well-known approach for fulfilling these demands. This leads to the derivative concept of Electronic Education Malls (EEM) [Langenbach & Bodendorf 1998] for educational contents and services, which provide a technological platform with appropriate value-added services and interfaces for suppliers and customers. Some examples are:

- An *education broker* provides specific search mechanisms for the retrieval of learning resources. In addition, he is responsible for the customization of media-based learning material according to individual preferences.
- An *advisory board* offers a didactically sound educational consultation.
- A *certification and quality assurance authority* is responsible for the certification of new courses as well as for quality assurance.
- A *marketing unit* develops individual marketing strategies in cooperation with the suppliers.
- An *accreditation authority* is responsible for the accreditation and registration of customers as well as for various other administrative tasks (e. g., issue and delivery of certificates).

- A *technology provider* supports suppliers during the production and delivery phase helping customers to use media-based resources efficiently.
- A *financial clearing authority* develops individual payment systems, negotiates selling prices, special conditions, discounts, etc. and handles the clearing between supplier and customer.

From an educational point of view, the broker service is of central importance because the quality of the learning process is strongly determined by the quality of the available materials and their configuration to an integrated course according to a pedagogical concept and the respective customers' needs. On the other hand, the quality of the broker service depends on the quality of the tools used for the support of retrieval and customizing tasks and which are at the broker's disposal.

2 Web Course Customization as an Education Broker Task

In the current stage of our EEM research activities, dealing with the modeling of the various mall services outlined above, the education broker is seen as a human actor supported by a set of appropriate electronic tools. Against this background the transaction process of customizing a Web course according to the individual students' needs can be identified in an abstract way as shown in [Fig. 1].

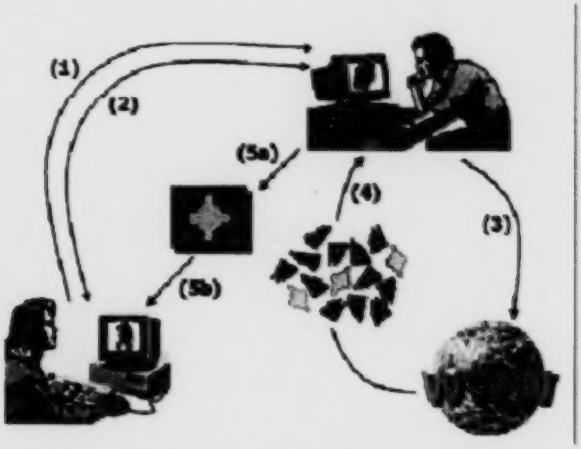

Figure 1: Transaction Process of Web Course Customization

In the first step (1) the customer (student) contacts the broker either asynchronously (e. g., via email) or synchronously (e. g., via videoconferencing) to ask for a course offer on a specific topic. In the course of the following communication process (2) the broker's task is to determine and operationalize the students' individual needs, preferences and specific qualification levels. An individual profile is generated based on the information gained. In the next step (3) this profile is matched with corresponding descriptions of educational Web pages (in the following referred to as 'learning modules'). As a result, a set of suitable learning modules is returned to the broker (4), ranked according to their 'fit' (= the relative quality of how well the respective criteria meet the requirements specified in the students' profile). The fine tuning task of customizing the course - crucial for its final quality - is now up to the broker. It includes the following sub-tasks (5a):

- selecting the 'right' elements out of the set of generally suitable learning modules
- adjusting and structuring the chosen learning modules to an integrated course in a pedagogically and didactically useful way
- adding navigational guides (e. g., guided tours)
- providing added values (e. g., means for student-tutor and student-student communication)
- delivering the integrated course and allowing an intuitive application by the student (5b)

To fulfil these tasks efficiently the broker has to bring in his pedagogical and didactical know-how as well as his specific experiences. In addition, powerful and flexible instruments should be at hand to support the respective steps.

With these demands in mind a set of tools is introduced in the following sections which are suitable for supporting stages (2) to (5b) of the customization process sketched above.

3 The Education Broker Toolset

3.1 The *PreSelector*

The *PreSelector* tool addresses stages (2) to (4). The user interface provides a questionnaire-oriented form which serves as a basis for determining and operationalizing the students' individual needs, preferences and specific qualification levels in the course of the broker-student communication.
Due to the fact that the determined criteria are crucial for the matching with the corresponding descriptions of the learning modules, two critical success factors for the whole customization process can be identified in this context: the items of the *PreSelector* form have to be well specified and the broker has to work very precisely to operationalize the students' answers according to the given items as exact as possible.
The problem is quite similar to the problem of specifying the 'right' keywords for a search engine inquiry. To support this crucial broker task, the *PreSelector* form basically provides two approaches: Firstly, an individual value can be assigned to each answer category of an item. By doing this, the importance of an answer category relative to the other ones of the same item can be determined. Second, a relative weight for each item can be set using a corresponding slider. The weight of an item reflects its relative importance. Furthermore, K.O. criteria for each item can be defined. These are answer categories which indicate that the respective requirements have to be fulfilled by the student in order to get the opportunity to apply a certain learning module. For instance, a student cannot handle a text written in Spanish if he does not have sufficient knowledge of the language.
After completing the *PreSelector* form all relevant data (the determined criteria as well as the assigned values and weights) is bundled into an individual inquiry profile which is used as input for the matching task with the corresponding descriptions of the learning modules. In this context, a corresponding item in the learning modules' descriptions must exist for each data set of the inquiry profile. The descriptions are stored together with the learning modules' URLs as meta information in a separate database.
This provides the means for a score-based comparison of all learning modules described in the meta information database. As a result a list of URLs of the most suitable learning modules ranked according to their respective aggregated scores relative to the maximum score attainable is returned to the broker for further processing. Basically, this list can be interpreted as an ordered pre-selection of learning modules from which the broker can draw to finally customize an integrated course.

3.2 The *CourseComposer*

The *CourseComposer* is designed to support the integration of the pre-selected learning modules which especially includes the adjustment and structuring of the materials in a pedagogically and didactically useful way. In our opinion, a full automation of this task - e. g., by using pre-defined course templates (cf. [Hämäläinen 1997]) – doesn't seem to be flexible enough for this specific purpose. In contrast, the broker should always be able to bring in his pedagogical and didactical know-how as well as his specific experiences during the fine tuning and customization phases. To support this approach, the *CourseComposer* provides its core functionalities and a set of added values via the user interface shown in [Fig. 2].
The *CourseComposer* frontend is subdivided into three parts: the *PreSelectionWindow* (1), the *PreViewWindow* (2), and the *CourseWindow* (3). The *PreSelector* output (the URL list of pre-selected learning modules) can be imported and visualized in the *PreSelectionWindow*. In this context the broker can decide how many of the pre-selected learning modules should be listed (e. g., only the 'best' 30% according to the score-ranking outlined in chapter 3.1). Learning modules which are basically well-rated by the *PreSelector* but which on the other hand are marked because of one or more K.O. criteria, are optionally listed below a separator.
By clicking on an URL in the *PreSelectionWindow*, the content of the corresponding learning module is visualized in the *PreViewWindow*. Now, the broker can 'manually' decide, whether the respective learning module is really suitable to be part of the demanded course or not. This decision is very sound because it takes the individual students' needs, preferences and qualification levels into consideration again and it is influenced

by the broker's pedagogical and didactical know-how, his specific experiences, and his personal impression of the respective learning module. If the broker finally decides to include the respective learning module into the course, he shifts the corresponding URL to the *CourseWindow* by simply clicking a button.

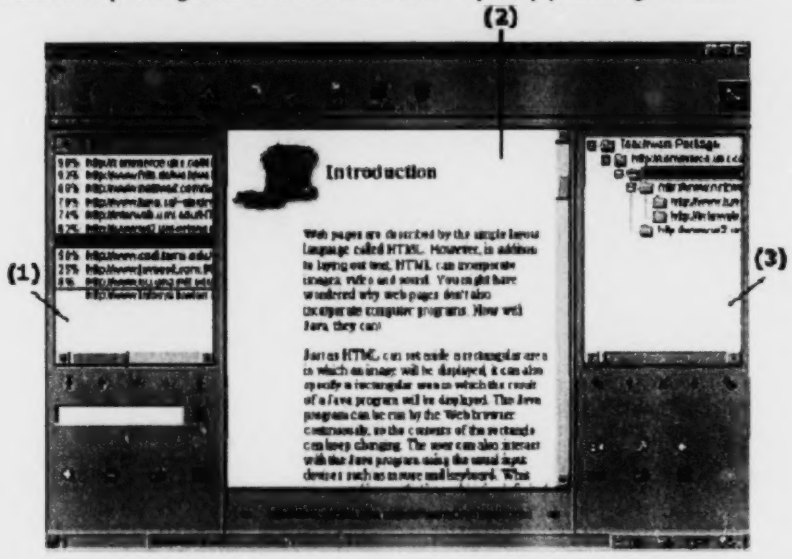

Figure 2: The *CourseComposer*

After finishing the decision process, the URLs of all learning modules selected by the broker as 'relevant' are listed in the *CourseWindow*. The next step is to structure the modules in a pedagogically and didactically useful way - again bringing in the specific broker's skills and taking into consideration the respective learner's profile. To support this task, the *CourseWindow* provides a tree-view for the visual representation of the URL entries collected there. Then, structuring the course can be done by assigning each learning module to a certain level of the tree and within a level to a certain position. This procedure is - in analogy to the structure of a book - equivalent to the assignment of a text passage to a certain (sub-)chapter. By clustering the learning modules according to this chapter paradigm, a navigational structure in form of a guided tour is inherently assigned to the course. All the necessary data for this (structure of the tree, URLs of the included learning modules, etc.) is stored as meta information in a common ASCII file (*CourseFile*). This *CourseFile* serves as the basis for the application of the course using the *CourseNavigator* (cf. chapter 4).
In the context of an individual course configuration, the *CourseComposer* provides a set of features to enrich the course with specific added values. These features can be activated via a corresponding button panel and include:

- Direct access to a HTML editor, which enables the broker to revise or adjust a pre-selected learning module according to his own ideas. Furthermore, the HTML editor can be used to compose a new learning module ad hoc which can then be added to the customized course. For this purpose, the adjusted or new learning modules must be stored on a broker's WWW server. The respective URL in the *CourseFile* is automatically adjusted.
- The opportunity to address and include learning modules which are not covered by the *PreSelector* but nevertheless should be part of the course according to the personal rating of the broker.
- Definition of means for communication amongst students and tutors (e. g., pre-addressed email forms for student-tutor communication or bulletin board systems for student-student communication).
- Integration of online manuals, online glossaries, etc. into the course.

4 Using Web Courses via the *CourseNavigator*

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The *CourseNavigator* (see [Fig. 3]) enables a student to access a course composed by the broker, supports navigational guidance (e. g., guided tours), and provides a set of added values. To fulfil the tasks of presenting the learning modules and providing flexible navigational guidance, the *CourseNavigator* uses the meta information stored in the *CourseFile*. According to its definition by the broker, the course structure is represented in a tree-view. The tree-structure implies - as mentioned above - a guided tour as a consequence of clustering the learning modules according to the chapter paradigm of books. Using the learning module in the root of the tree as the starting point (= the 'homepage' of the course), the inherent guided tour is defined as a sequence of chapters and sub-chapters.
In this context, the *CourseNavigator*'s buttons 'next' and 'previous' can be used to move one step forward or backward respectively on the guided tour. The 'up' button leads the student to the parent node in the upper-next level relative to the location of the current learning module. If the student leaves the guided tour to freely explore additional sources of information by following external links integrated into the learning modules, the 'previous' button allows a direct return to the guided tour. Obviously, each learning module of a course can also be accessed directly by clicking on the respective entry in the tree-view.
Besides the navigational guidance, the *CourseNavigator* provides further course-specific and broker-defined added values (cf. chapter 3.2), reachable via dedicated buttons. Some examples are: an online manual, an online glossary, specific means for student-tutor communication (e. g., pre-addressed email forms) and a bulletin board system for student-student communication.

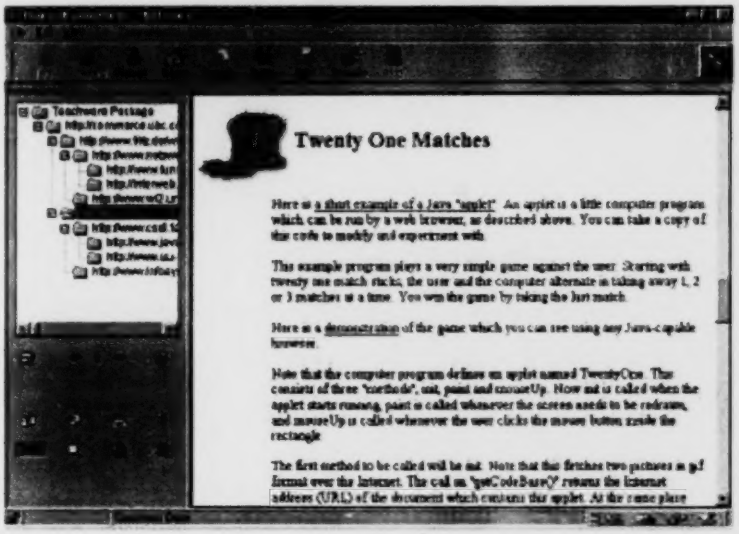

Figure 3: The *CourseNavigator*

5 Experiences and Outlook

Taking into account the increasing commercial structures in the fields of education and training in recent years, media-based teaching and learning concepts with promising market potential are being prototypically realized and evaluated at the University of Erlangen-Nuremberg (cf. [Bodendorf, Grebner & Langenbach 1997], [Langenbach & Bodendorf 1997]). Alongside those content- and application-related research activities, systems supporting communication and coordination tasks between suppliers and customers in an emerging Electronic Education Market are being focused on. In this context, the Electronic Education Mall concept seems to be a promising approach. Among the multitude of specific services provided by an EEM, the broker service is of special interest because this intermediary is responsible for the individual customization of learning resources according to the respective students' needs, preferences and qualifications.
To support this crucial task, the education broker toolset introduced in this paper was designed and prototypically implemented in Java. A first evaluation of these tools took place in January 1998. Three lecturers

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of our university had access to the *PreSelector* and the *CourseComposer* in order to customize Web courses for a group of test students. The feedback of all participants was mainly positive. The lecturers described the tools as stable, easy to handle, and the layout of the user interfaces as well structured. They particularly appreciated:

- the chosen approach to operationalize the students' needs, preferences, and qualification criteria by assigning individual values and weights,
- the ability to bring into the customization process their pedagogical and didactical know-how, and
- the value adding features of the *CourseComposer*.

The students confirmed the intuitivity and flexibility of the navigational aides provided by the *CourseNavigator* as well as the value adding features (especially the means for student-tutor and student-student communication). One negative aspect highlighted by the lecturers was the limited size of the test set of learning modules from which they could draw. In order to achieve a broader evaluation platform, this set as well as the database of learning modules' descriptions are to be enlarged in the next months. In this context, an automated indexing of learning modules would be a very helpful feature. This is considered as an interesting field for future research activities with rich potential for innovative soft computing approaches.

Furthermore, the students' remarks showed the desire for additional value adding features Promising ideas for further development include:

- a monitoring component which depicts the progression of students' learning process
- adaptive and generic modules to automatically adjust and generate guided tours according to the current students' navigation and learning behaviour

Besides the improvement of the already existing broker tools, the design and development of additional services and tools (e. g., systems to support the mediation of human resources like tutors, coaches, and trainers) and their integration into an education broker system providing a self-service-oriented, homogeneous user interface is planned. In parallel, support systems for various other transaction tasks in an Electronic Education Market are on the agenda, e. g., flexible accounting and payment systems for the financial clearing provider, and electronic product and service catalogues for the marketing unit of an EEM.

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An Experiment Using Document Annotations in Education

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Abstract: This paper describes an on-going experiment at the Swiss Federal Institute of Technology in Lausanne regarding the use of Web based document annotations for educational purposes. An annotation tool called Medium was built, merging database and Web technologies that will be used as a companion for classical university courses and collaborative learning experiments.

1 Introduction

Document annotations are a very old concept. Much business and academia work is accomplished through annotation of documents. The usual scenario is that of a member of a group producing a document, which is then distributed to the group members for review. Each member reviews their own copy of the document and later returns the annotated document to the author. The author merges the comments into the document and produces a new document for review. After a number of iterations the document is declared final and is typically published outside of the group.

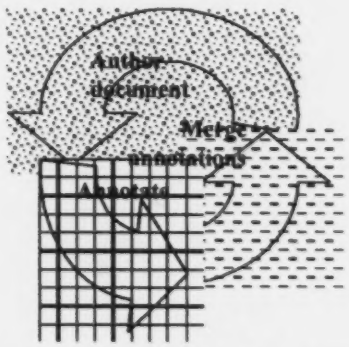

Figure 1: The document refinement process

As the document is refined during these iterations, the knowledge of the group and its understanding of the domain grow. So this is in fact a group learning process centered on the document and its annotations. This process is typically made more complicated when the document is authored by several members of the group simultaneously.
Annotations are mainly used in education for the purpose of producing teaching material which boils down to the same process as outlined above. Our intent is to use annotations within the teaching or learning process itself, e.g. as a companion for the classroom experience.

2 Annotations Versus News Groups

It is our belief that news groups lack the contextual binding that exist between a document and its annotations. News groups threads tend to diverge after a few iterations making them incomprehensible for the newcomer. Many times in order for the reader to understand a certain message of interest they

need to follow the thread the first message. Annotations, on the other hand, share a very strong context, which is the document itself. This is both a good thing and a bad thing. It is good because it helps users to understand the annotation and comment on it. It is bad because it may hinder people from annotating for fear of saying wrong things thereby showing their misunderstanding of the issue at hand.

3 Other Annotation Tools

Since annotations are not a new concept, one could expect to find many annotations tools available. The mainstream tools that support annotations are word processors such as Microsoft Word and groupware products such as Lotus Notes. In the past few years we've seen the emergence of Web based annotation tools. Some examples we found are the following:

- The ComMentor project at Stanford University is an early effort intended mainly as a proof of concept of the feasibility of Web annotations [Röscheisen et al. 1994].
- FEED Magazine (http://feedmag.com) operates a forum where readers can comment articles posted by authors. This is, however, not a fine-grained annotation tool [Drexler 1987] because annotations can only be placed within hooks (called loops) provided by the author.
- CritLink Mediator (http://crit.org) is a direct descendent of the ideas exposed by Drexler. It is aimed at enabling people to annotate any Web page using a proxy-based architecture.

4 Design Constraints

From the outset of the project, we formulated the following design constraints:

- Comments can be made on any portion of a text, fine grained annotation as defined by Drexler [Drexler 1987]
- Users will have to log into the server. This help us identify them and insures some filtering since non-authorized users can not contribute comments
- The user interface should be designed so that it operates well with small screen resolutions e.g. 640x480
- Medium should operate well when used with a standard 28K modem connection
- Medium should be usable with any Web browser supporting HTML frames and JavaScript. Users should not be required to install extra client software such as a plug-in
- The user interface should be as modeless as possible

5 Architecture

Medium's core technology is an Object-relational database engine (Informix Universal Server) and its extensions in the form of DataBlade modules which extend the capabilities of the server with new user-defined data types and related methods. Of the multitude of existing datablades we use the following 2:

1. The WebDataBlade, interfaces the database with Web the server and browsers
2. The TextDataBlade, implements basic text search

The front-end can be any browser that supports frames and JavaScript. The user interface is implemented through HTML pages with JavaScript code. The HTML pages themselves are generated dynamically from the database. JavaScript allows to automate the HTML forms so that a Submit button is not required in order to execute an action. For example, when the user selects a document from the document list Medium immediately loads the selected document.
Since we are using a central database, documents have to be imported before they can be annotated. We will discuss later what documents can be imported and from where.

6 Development Process

We chose to use an incremental development process. The intents was to have the basic system up and running in a matter of a few weeks and from than on refine by taking into consideration user input and extending the functionality by taking into consideration users and developers wish list. Thus, we chose to use low tech. technologies, which allowed us to have fast turnaround cycles.

7 Features and Restrictions

Medium offers the following features:

- Annotations of different types: Text, Java applets, VRML scenes, Audio clips
- Text Annotations can HTML tags. For less advanced users, an optional link field is provided allowing them to include a reference to a Web page that is attached to the annotation.
- Named annotations, an optional name can be specified when an annotation is added
- Annotations can be updated or deleted only by their author
- Annotations are public, anybody who connects to the server even as a guest can see them
- Annotations carry a timestamp and the name of the annotator
- Original documents are never altered. Annotations appear as a layer on top of the original
- Contributions can be viewed by document (called contribution) and by contributor

Medium supports importing of HTML and Tex documents. HTML documents can be imported from the local disk or directly from the Web by supplying their URL. The latter is the preferred method since documents can than keep their images, applets etc, which are loaded at runtime from the server from which the document was imported. This of course requires that these images and applets will not be deleted from the original server, which is not always in the hands of the contributor.

Medium has the following restrictions and limitations:

- URL's within a document can not be annotated
- Images can not be annotated
- HTML documents loaded from a local drive will lose the images and applets that they contain

8 User Interface

The user interface of Medium has been optimized from the beginning to encourage people to annotate. Thus, there are only 2 required fields for a text annotation:

1. The text to annotate
2. The text of annotation itself

All other fields are optional. They take default values if not used. For instance, the name field, which is used to give an explicit name to the annotation, defaults to a number if left empty. Medium will automatically assign a number, increasing from 1 for the first annotation, and apply it to a non-named annotation. This makes the process of adding an annotation very efficient, enabling users to concentrate on their annotations rather than on the mechanism of annotating.

9 Evolution

Up to this date, we can clearly identify 3 stages in the evolution of Medium issued from the incremental process described above. In the following figures, the left pane shows the original document whereas the right one represents the document with an annotation.

9.1 First Design

The first design involved four frames [Fig. 2], frame 4 for the document and three others to manage projects, to enter and view annotations and a frame that enabled users to select documents and annotations within a project. For each contributor we collected in the database the original document and annotations. Major disadvantages: The area allocated for viewing the document was too small, users were lost in all these frames, information was duplicated between frames. The annotation process required the user to select the text to annotate and copy it into the annotation form, then enter the annotation text itself and any optional fields and submit the form.

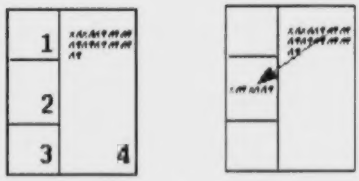

Figure 2: First design

9.2 Second Design

The second design involved only two frames [Fig. 3]: The largest frame was allocated for the document and the horizontal frame underneath was used for handling all the interactions with the user. Using the getSelection method of JavaScript we were able to capture the selected text in the document frame and insert it automatically into the text to be annotated when the user chose to annotate, thus reducing the process of annotating by one step. This however only works with Netscape browsers version 4.0 and higher. Curiously, it does not work with the latest Microsoft browsers. Annotations are displayed directly in the document when the user selects one.

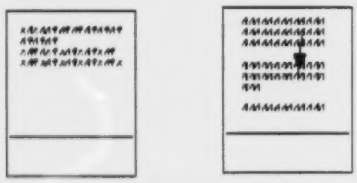

Figure 3: Second design

From the database design point of view, the advantages are that we don't duplicate information, one table named "medium" and complex data types are introduced (doc_t and note_t). Following are SQL code snippets, which show the usage of these data types:

```
create table medium (
document        doc_t,
note            note_t,
data_txt        html,
data_blob       blob) put data_blob in (sblobspce),data_txt in (sblobspce);
```

note_t is a named row type as follows:

```
create row type note_t (
owner           user_t,
name            varchar(10),
where           varchar(50),
abstract        varchar(40),
count           integer,
type            integer,
update          datetime YEAR to second,
language        varchar(10));
```

We assemble the original document and annotations with JavaScript. Major disadvantages:

- For large sized documents (> 100K), annotation access time is too long
- The JavaScript program consumes too many resources on the client side
- Each time an annotation is opened or closed, the whole document needs to be reloaded which takes a long time and interrupts the thought process of the user.

9.3 Third Design

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The third and current design keeps the two frames concept explored in the previous design but there is no more reloading of the document when the user requests an annotation. Instead, annotations of type text, are displayed in the bottom frame, other types (VRML scenes or Java Applets) are displayed in a new browser window. Audio annotations are simply sent to the audio player with no display involved. The search for the text to be annotated which was based on simple substring matching is now performed through the text search DataBlade module which enables Medium to search information in ways that are more sophisticated such as exact, fuzzy searches and synonym matching.

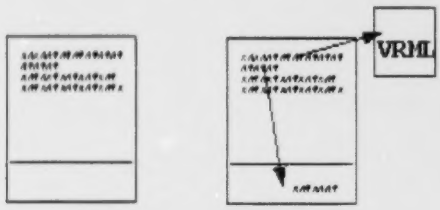

Figure 4: Third design

10 Extending Medium

We have realized that annotations lead to discussions so that people want to use Medium as a groupware tool. In order to support discussions we are considering adding the following functionality:

- Contextual chat, users will be able to start a conversation with other users connected to Medium at the same time. Our aim is to enable users to not only see that other people are present in the system but that they may be in the same context. For now, we define the context as being the document. This will enable the system to alert user A to the fact that user B may be reading or annotating the same document as the one user A is reading.
- Concept map description of document, concept maps are very useful to graphically describe a document. We want to explore the feasibility and impact of enabling people to annotate a document with a concept map which is linked with the document so that clicking on symbols in the concept map trigger the display of the corresponding area or keyword within the document.
- Annotations within annotations, users should be able to annotate an annotation thus sparking of a discussion. This, in essence, will make the document be the basis of a groupware process.
- Annotation scope, since people may feel uncomfortable with the public nature of annotations, we are going to introduce a scoping property which will enable users to add annotations which are private, visible to a group of users or public.
- Cross referencing documents, Using simple text analysis tools it is possible to take advantage of the fact that all documents are in the same database and that we can use a common dictionary and thesaurus to link keywords to their definition and to their references in other documents [Fig. 5]. The whole process should be automatic so that when a user views a document, the keywords that are in the dictionary appear as links which, when selected, display the list of definitions and references. Selecting a reference displays the related occurrence of the keyword in the referenced document.

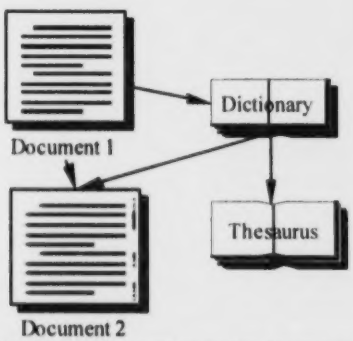

Figure 5: Cross-referencing documents

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11 Medium as an Education Tool

As a companion for a classical university course, Medium could be used by the professor and assistants in order to illustrate the course with examples, provide errata and even ask students to supply their own examples as annotations of the basic course. A typical scenario involves the professor making their course material available for annotation. Students then read the material at their leisure and annotate it with their questions and comments. The professor and assistants periodically browse through the annotations, answer questions and take action on comments by inserting their own annotations or through email if necessary. Since annotations can be other than text, it is possible for users (professors, assistants and students) to illustrate the course with examples, which can be graphical and even interactive.

12 Conclusions

A basic version of Medium is now available with which we are satisfied from both the user interface, performance and stability points of view. We have had less luck with participation in Medium. Most people who were granted access rights never quite made it to adding comments. The instability of the tool from the availability, performance and user interface points of view may have prevented some users from adding their comments, but we also believe that people are drawn back by the public nature of Medium and the strong context that exists between the annotation and the document as explained in [Annotations Versus News Groups]. with the solution being the scoping of annotations as explained in [Extending Medium]. This will be particularly important for the education field where students may feel uncomfortable with making their annotations public at first. Students may feel more comfortable adding their annotations while keeping them private and only make them public once they feel comfortable enough with the course material.

We hope to start several collaborations in order to evaluate the adequacy of Medium for higher education and for desktop publishing in a research institute. A public version of Medium is available on the World Wide Web at the following URL: http://sgwww.epfl.ch/medium

With hindsight, we think that the real potential of an annotation tool will be to offer it as a service. By service we mean a module with no user interface that offers annotation services to Web applications by exposing an API. By API we mean an HTML form based API.

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Engaging Adult Learners Online: Strategies for the Development of a Web-based Professional Development Program in the University System of Georgia

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Abstract: The Office of Information and Instructional Technology, Academic Innovation, of the University System of Georgia is involved in the delivery of technology based professional development programs for faculty and staff within the 34 institutions which comprise the University System. With the growing need to reach a geographically dispersed audience, a variety of distance learning opportunities have been developed, including Web-based training and development programs. It is possible on the Web to create learning space in which to meet, make presentations, hold discussions, work collaboratively in groups, and have at hand a vast supply of resources and information. The design and implementation of successful Web-based professional development programs should take into account the issues that characterize the needs of adult learners. Effectively engaging adult learners in an online environment involves (1) setting a climate that is conducive to self-directed learning, (2) understanding the role of the facilitator, and (3) selecting appropriate methods for program delivery.

1. Introduction

The Office of Information and Instructional Technology (OIIT), Academic Innovation Unit, of the University System of Georgia (USG), is involved in the design and delivery of technology based professional development programs for faculty and staff within the 34 institutions which comprise the University System. With the growing need to reach a geographically dispersed audience, a variety of distance learning opportunities have been developed, including Web-based training and development programs. It is possible on the Web to create learning space in which to meet, make presentations, hold discussions, work collaboratively in groups, and have at hand a vast supply of resources and information. The OIIT has begun a project to offer professional development programs over the Web through "University System of Georgia, Academic Innovation Online", a Web-based conference environment. Recent offerings generated requests for participation from faculty and staff from within the University System of Georgia and from an international audience as well. This paper will highlight factors and issues related to the design of the programs previously offered or under development at this time. Further details about program development, evaluation, and lessons learned will be shared in November at WebNet 98.

2. Background

At the present time, Academic Innovation is using Web Crossing, a Web-based conferencing system, to deliver educational programs over the Web . In August of 1997, a Web-based conference was offered to a group of 60 faculty participating in the Faculty Development Workshop. The conference took place over a three day period with presenters in Washington, D. C. and Atlanta, Georgia and with participants in Athens, Georgia. Both synchronous and asynchronous modes of communications were used. Presenters provided

conference materials and assigned readings for participants prior to the conference. Presenters were available to lead discussions, and answer questions for faculty who worked in groups to design scenarios for discussion.

In May of 1998, a Web-based conference entitled "Teaching Over The Web" was offered to over 500 participants over a two week period. This conference involved presentations and group discussions on the topics of Web Course Management Systems and Teaching Strategies for Web-based Course Delivery. Presenters from four countries made presentations and lead discussions over a four day period each week.

Future plans for using web-based conferencing include two major conferences during the upcoming year, as well as using the system to support the communications and distance learning activities of the 1998/1999 Faculty Development Institute participants.

3. Designing Web-based Educational Programs for Adults

The design and implementation of USG Web-based professional development programs is based upon theories of adult learning. The principles of Andragogy, as described by Knowles (1980), suggests several important characteristics of adult learners that can help to guide the development of Web-based educational programs for adults. Effectively engaging adult learners in an online environment involves a variety of strategies such as the following: (1) setting a climate that is conducive to self-directed learning, (2) understanding the role of the facilitator, and (3) selecting appropriate techniques for stimulating dialogue and thoughtful participation.

3.1. Setting the Climate for Self-directed Learning

An assumption about adult learners is that they are primarily self-directed in their learning activities Web-based learning is highly self-directed by nature, and learners must take the major responsibility for their own learning. It should be noted that self-directed learning does not happen in isolation. Rather, successful self-directed learning involves collaboration and support among learners, teachers, resource people, and others (Merriam & Caffarella, 1991). When designing Web-based educational programs for adults, it is important to create an online environment that is conducive to learning, and one that encourages and supports the self-directed learner. Setting the climate includes providing an orientation to the environment, creating ambiance, creating opportunities for social interactions, and guiding the learning process.

3.1.1 Orientation

It is important to provide an orientation to adult learners about how to participate, what to expect, and how to find help. The orientation should include a tutorial or help session for the conferencing software so that participants have a chance to become familiar with the conferencing environment they will use. The practical issues often include gaining access to the discussions, how and where to post messages, checking for new messages, and starting new discussions. Regarding the learning activities, learners should know what to expect in terms of goals and objectives, time commitments, the nature of asynchronous communications, and other practical issues which will influence their approach to participation. It is useful to establish help areas and online support so that participants can ask questions that may not have been addressed elsewhere.

3.1.2 Creating Ambiance

Web-based educational program developers must create a virtual classroom which conveys the tone for the learning environment. It is important to create a comfort level for learners that will encourage them to contribute, explore, and communicate with people that they may never see in a face-to-face situation. Establishing a climate of trust and safety will enhance this communication. In part, this means establishing an environment that is conducive to relationship building among participants and encourages collaboration

and open exchange of ideas. Self-directed learning will be stifled in an environment where learners cannot express themselves or draw upon the people and resources readily available to them.

3.1.3 Creating Community

An important aspect of setting the climate with adult learners is to welcome them to the group and provide opportunities for sharing personal experiences. An important aspect of a face-to-face meeting is social interaction. The virtual meeting space must accomplish this as well. It is helpful to welcome all participants and provide opportunities for sharing experiences. A useful technique is to have participants introduce themselves to the group, share their experiences, tell what each hopes to gain by participating, and describe the knowledge or skills they can contribute to the group learning process. This type of exchange is important to adult learners, in that it validates their experiences and helps to establish their potential as valuable resources to draw from.

3.2 The Role of the Online Facilitator

Because of the self-directed nature of online learning, the role of the teacher becomes that of facilitator or manager of the learning process. Guiding the interactive learning process in an online environment involves pedagogical, social, managerial, and technical tasks, such as those described above, as well as many others. Teaching over the Web requires an understanding of the issues related to learning online, and a willingness to adapt teaching strategies and methods to meet the needs of online learners (Berg, 1996; Paulsen, 1995). It is often helpful for teachers and those responsible for designing Web-based educational programs to become learners themselves in a Web-based program in order to appreciate fully the tasks related to learning from the Web.

3.3 Formats and Methods for Engaging Participation

Logistics and instructional methods for online instructional programs for adults must take into account the nature of the virtual environment and the barriers to effective participation posed by the lack of face-to-face contact. Selecting procedures and methods for engaging active participation must be given careful consideration.

The symposium/forum concept has been successfully used for USG Web-based Conferences. The symposium component allows for the presentation of information, informed opinion, and clarification of the topic by designated expert resource persons. The forum component permits further exploration of issues raised in the symposium, and enables participants to contribute ideas, engage in discussion, and ask questions of the resource persons. An example of this format can be seen in the Teaching Over The Web conference archive available at <http://deai.peachnet.edu/cgi-bin/WebX>. Log in as Guest to gain access to the archive.

4. Conclusion

The USG Web-based educational programs have been developed to meet the growing needs of a geographically dispersed University System of Georgia audience. The Web provides the opportunity and the potential to reach a growing community of life-long learners and adults who need continuing educational programs at a distance. Recent offerings generated overwhelming requests for participation from faculty and staff from within the University System of Georgia and from an international audience as well. Feedback and evaluation about the programs indicate a high level of satisfaction among participants. The USG Academic Innovation Online Web-based programs are a work in development.. Further examples and data will be provided at the time of this paper presentation at WebNet 98.

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Rio Internet TV - AulaNet™
Using Videoconference in Web-Based Learning

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Abstract: This paper presents the results of an experiment using videoconference as a teaching resource in distance courses. CU-SeeMe and Real technology were tested for transmitting lessons live and recording lessons for asynchronous attendance. The results were assessed for later use in AulaNet™—an environment for web-based learning.

1. Introduction

Education is gradually drifting towards the use of computer technology more and more, in particular the World Wide Web. The possibilities for web technology in education only began to be seriously explored at the end of 1996, when the term web-based education became more widespread. International Data Corporation [IDC 97)] believes that the enormous growth of web-based education and training, either through corporate intranets or the Internet that took place in 1997 is just the beginning, and that it will explode into a 2 billion dollar market in the year 2000. The main driving force for web-based training is the necessity to discover ways of bringing training directly to the desktop in a continuous just-in-time way—in order to train people with new abilities or knowledge.

The growing tendency of the traditional media to use digital technology plus the increasing amount of people who use computers in their professional and domestic environments is gradually transforming the way information is consumed [Tapscott 98] and creating a new culture of digital communication. The traditional learning process in a confined space like a classroom where the teacher appears at a set time and place and broadcasts information to a group of students is currently being questioned [Romiszowsky 97].

AulaNet™ <http://www.les.inf.puc-rio.br/aulanet/> is a software environment based on the World Wide Web being developed in the Software Engineering Laboratory (LES) of the Computer Science Department at the Catholic University of Rio de Janeiro (PUC-Rio) to create, give and attend distance courses. AulaNet™ [Lucena et all 97] was conceived as a result of the experience gained from three specific courses given at PUC-Rio during the second semester of 1997.

One basic element of the learning process is interaction between the various participants of a course, whether between instructor and students, or the students themselves, etc. One technology that can be used to facilitate this interaction is videoconference.

Rio Internet TV <http://www.inf.puc-rio.br/~refletor/> is a research nucleus within LES at PUC-Rio. One of its main objects of study is the use of videoconference as a tool for cooperation in groupwork [Laufer & Fuks 97].

In this work we present an experiment that was undertaken during the second semester of 1997 by Rio Internet TV using as a base a graduate course given in this department. The course, entitled Information Society <http://www.les.inf.puc-rio.br/socinfo>, was given by Professor Carlos J. P. Lucena and dealt with the impact of information technologies—a symbiosis between computing and communication—on society. To a large degree this impact is already visible in contemporary society and could produce a new type of society in the future that is already being called the "Information Society". The purpose of the experiment was to test current technologies, i.e. audio, video and text, through the Internet and to assess their performance and impact on a distance course.

This document is structured in the following way: section 2 presents videoconference concepts and the technologies used in the experiment; section 3 presents the experiment; section 4 has an assessment of the results of the experiment and finally in section 5 the conclusion and future work are presented.

2. Videoconference and the Technologies used in the Experiment

Videoconference technologies have been in a process of evolution since 1964 when AT&T launched the first system - the Picturephone - at the World Fair in New York. In the beginning only proprietary technologies existed. Since then these technologies have been evolving in a way that has made them less expensive and more flexible, so that they can be used on a greater number of platforms.

Only recently has the use of videoconference technologies on the Internet been studied with greater attention. The technologies that compress audio and video are reducing the amount of information to be transmitted through the networks, at the same time that the width of the band which transmits the data is tending to grow, and will continue to do so in the next few years. Initially, due to the expensive equipment and running costs, videoconference was mainly used by large companies to hold meetings with their executives spread around the world in branch offices. Nowadays, there are a large number of softwares available on the Internet that offer the possibility of communication through audio and video at a low cost [Schindler 97].

The experiment conducted involved two videoconference technologies that are widely used on the Internet.

The first technology used to transmit lectures was CU-SeeMe, initially developed by Cornell University in the United States. The CU-SeeMe reflector is a server that enables many participants to connect to a videoconference. By connecting through a client—which could be White Pine Software's commercial version <http://www.wpine.com> or Cornell University's academic version <http://cu-seeme.cornell.edu>—it is possible to connect to a CU-SeeMe reflector and take part in a multimedia conference with audio, video and text.

CU-SeeMe is suitable for transmissions that need interaction, like for example, question and answer sessions, consultations etc. For the purpose of this experiment we used PUC-Rio's reflector—Rio Internet TV—the first public reflector in Brazil, that appears in lists all over the world, including the phone book distributed by White Pine. It began operating in 1994 and receives hundreds of visitors every day (more than 500), and has a Web site that serves as a source of information for the CU-SeeMe community in Brazil <http://www.inf.puc-rio.br/~refletor>. The Rio Internet TV reflector is for public use, it functions 24 hours a day and there is a videoconference room available (room 0) that can accept the participation of up to 30 people.

The other technology tested during the Information Society course was the one developed by Real Networks <http://www.real.com>, that broadcasts and records audio and image. This technology also uses the client/server architecture. The Real server is responsible for supplying audio and video streams compressed by a proprietary algorithm. The client side consumes the streams through a specific software—Realplayer—or as a plugin in a browser, thus enabling the image and audio to be presented on a Web page. Real technology transmits video streams that are consumed by the client side, therefore it is not necessary to wait for the the files to be completely transferred. The advantage of this technology is that it buffers the audio on the client's side in order to guarantee continuity in the sound, which is critical for the information to be understood.

As well as transmitting and recording lectures live, Real technology can also transmit files containing audio and video streams in a specific format, compressed at a high rate, through the Internet. Thus, lectures that have previously been recorded may be transmitted upon request through the network, as can any video edited through other technologies and converted to the Real format. However, Real technology does not yet offer the possibility of interaction between the participants of a videoconference.

3. The Experiment

The experiment was divided into stages and phases so that a step by step assessment could be made of the technologies used. They are explained in detail in the following paragraphs.

3.1 Stage 1

The objective of the first stage was to transmit the lecture live so that it could be watched at a distance together with the course site. The aforementioned Reflector was used to carry out this stage. A special

classroom (Room 10) was created in the reflector and only the machine installed in the classroom had permission to send audio and video. The other participants could only communicate via chat.
A Pentium 100 with 40 Mb RAM running Windows 95 was used to transmit the lectures. The camera used was a Colour QuickCam <http://www.connectix.com>, that dispenses the use of a video capture card. This camera is directly connected to the computer's parallel port and all the image processing is carried out by software. A four channel table with two microphones connected to it was used to capture the sound. The professor used a lapel mike to transmit the lecture and another microphone was made available for the students to ask questions at the end of the lecture. The same machine used for transmission was also used to show the slides, running Microsoft's Power Point software.
This first stage was divided into three phases. In the first phase the Reflector's public room remained open to the public and the transmission rate was 80 kbps.
In the second phase the Reflector's public room was closed for the sending of audio and video which noticeably improved the quality of audio and video received by the students. Some students even sent us sections of audio recorded by them from various locations proving the good reception of the audio.

Figura 1 - CU-SeeMe windows

The presentation format of the lectures was similar to that used for giving speeches. Only when the instructor had finished speaking were the students allowed to ask questions. This strategy aimed to minimize interaction during the lecture. As there was only one microphone for the students present in the classroom and they were not accustomed to this type of lecture transmitted live, some of the discussions were lost, as the students did not remember to speak directly into the microphone. Thus, the more rigid structure of a speech followed by questions was opted for. At the end of the lectures, the students physically present in the classroom asked questions through the microphone while the remote students asked questions through a CU-SeeMe chat window. The questions sent by remote students were received by the instructor's assistant and read out loud through the microphone in the audience. Therefore, it was as if a student physically present in the classroom was asking the question.
In the third phase the transmission rate was raised to 300 kbps and a Pentium 200 with 64 Mb RAM running Windows NT was used exclusively for transmission via CU-SeeMe.

3.2 Stage 2

The object of the second stage of the experiment was to transmit the lectures live and to record them for later use by the students. As well as being transmitted by the Reflector, the lectures began to be transmitted and recorded via Real technology. In order to do this a Real live encoder was used to code the lectures while they were being transmitted to the server.
This stage was divided into three phases. In the first, only the audio was transmitted by Real technology using a Pentium 100. The Pentium 200 continued transmitting the lecture through CU-SeeMe—audio, video and chat.

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The second phase involved recording the audio through Real technology. Transmitting and recording the audio through Real demanded greater processing capacity; so the Pentium 100 was replaced by a Pentium 200 as the processor compresses the audio signal generated during transmission. The rate used for audio transmission through Real was 6.5 kbps.
In the third phase the video was also recorded using Real technology. In order to record the video a much more powerful machine was needed than had previously been used in the experiment. The specified machine was a Dual Pentium Pro 200 with 128 Mb RAM, Windows NT, an Osphrey 100 video capture card and a Videolabs Flexcam Pro video camera with S-Video output instead of a QuickCam. The transmission rate of the audio and video together through Real was 20 kbps.

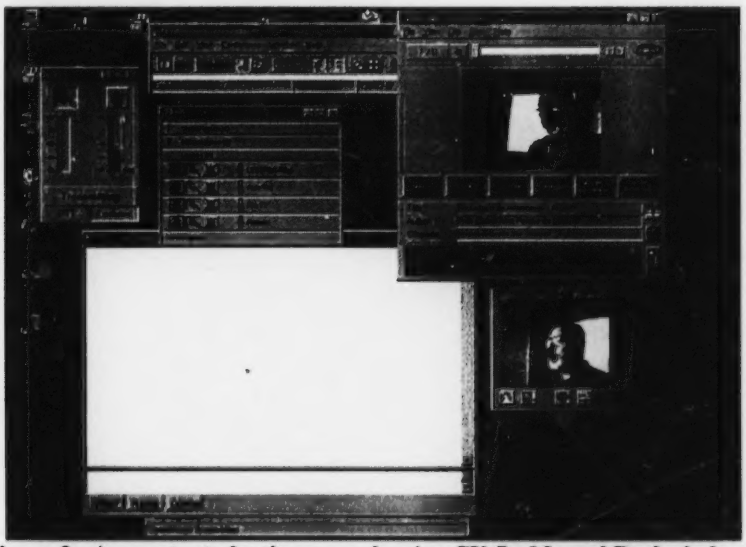

Figure 2 - A remote student's screen showing CU-SeeMe and Real windows

Figure 2 above shows how the screen looked for remote students following lectures during this phase. We can see the CU-SeeMe windows and the RealPlayer window with Professor Lucena's image.

3.3 Stage 3

The object of the third stage was to make the recorded lectures available so that the students could watch them asynchronously.
The course site was reformulated enabling the students to follow the video and audio of the lectures together with the slides presented by the instructor, through the use of a browser running on any platform. In order to do this Real plug-in must be installed in the browser. This plug-in could be downloaded from the course site as well as the installation guidelines.

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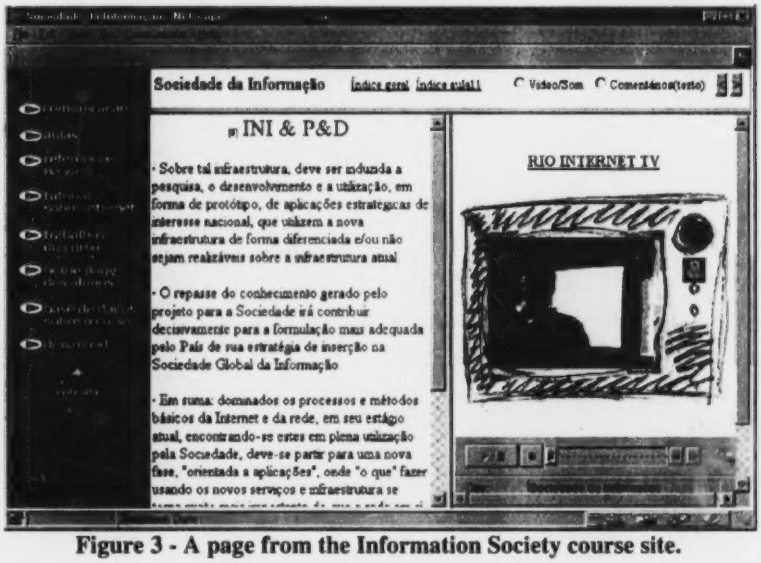

Figure 3 - A page from the Information Society course site.

Figure 3 above presents a page from the Information Society course site containing one frame with slides and another frame with the video of one of the lectures presented by Professor Lucena.

4. Assessment

Within PUC-Rio's internal network reception of the lectures through CU-SeeMe was very good, presenting continuous audio and well defined images. Outside PUC-Rio reception varied greatly depending on the participants' individual connection. The greatest problem was a discontinuity in audio because CU-SeeMe does not buffer the information transmitted.

It was observed that the audio transmitted by Real arrived with greater continuity despite the initial delay which was longer than that of CU-SeeMe. In figure 2 one can see a delay between the images shown in the CU-SeeMe window and those shown in the Real window. This delay is adjusted by Real's buffering mechanism, resulting in less information loss and greater continuity—which is critical for audio. Distance participants reported good reception of audio and video with some interruption in the audio, but as buffering does exist the information was received.

While the previously described experiments were taking place, we also undertook other activities with the purpose of better assessing how effective the distance lectures were. During the course another room was set up in another building on the campus, inside the same LAN, where some of the students could follow the lectures. In this environment, the speed of the network was approximately 2Mbps, much faster that than obtained by students watching the course through an ISP using a 28.8 kbps modem.

The group of students that watched the lectures in the second room at PUC-Rio (three groups of two students) told us that, to a certain degree, they achieved a greater level of concentration, because they had to pay more attention to the screen in order to follow the lecture. As this group of students had previously attended various lectures with Professor Lucena physically present, they were in a position to make a comparison between lectures with the instructor present and distance lectures. They also told us that as the classroom was dark due to the slide showing and full of equipment needed for the transmission, to a certain degree, it was less pleasant than the room in which they watched the lecture at a distance. Inside PUC-Rio the sound transmission was quite clear and enabled students to follow the lectures well.

One difficulty that the remote students encountered was slide changing. The slides for each lecture on the course were put on the course site. During the live lecture the remote students could receive the audio and video of Professor Lucena transmitted through CU-SeeMe and Real and followed the lesson through the slides put on the site. However, as there was no synchronization mechanism between the classroom browser and the distance browsers, the remote students did not know when the professor was changing the slides. This problem was minimized by one of the professor's assistants informing when the slides were changed through CU-

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SeeMe chat. During the course, the professor also adapted his presentation and began to indicate the slide he was currently talking about in order to facilitate comprehension for the remote students.
Another difficulty encountered by the participants in this experiment was related to the technical part of the transmission and recording. Lighting and camera positioning, to name but two examples, can make a big difference to the final result. Neither the professor, nor the staff in charge of the equipment had any experience in this type of activity. The professor gave the lectures normally directing himself to the people present, which is not necessarily the best way for the remote students. There are still limited resources for editing the recorded lectures. In a live lecture there are many interruptions that do not make sense in a recorded and edited version of a lecture. Unfortunately, at the moment, editing resources for Real files are quite precarious, which makes it difficult to take out the errors.

5. Conclusion and Future Work

The experiment in this work involved using two Internet videoconference technologies on a graduate course in the Computer Science Department at PUC-Rio.
CU-SeeMe technology proved to be suitable for synchronous events where interaction is necessary between participants, for example, group study meetings, and sessions between monitors and students to clarify doubts, etc.
Real technology proved to be suitable for broadcasting information, where interaction is not necessary, as it provides good quality audio and video, low transmission rates and good continuity in the audio, which in the majority of cases is the most critical part.
One matter that became quite clear through the experiment was that it is necessary for the instructor/presenter and the recording team to have more experience in this type of event. The transmission and recording of the audio and video demands skilled personnel. The instructor must have a posture suitable for appearing on camera, as well as a clear vocal pitch. Aspects that we consider to be mere details, like the color of the clothes worn by the instructor, may create important effects that only professionals have the capacity to give guidance on and make accurate assessments about. The video and audio must be interesting, not only from the point of view of content of the lectures, but also from the point of view of the media used. We are faced with a new form of consumption of information. Instructors will have to develop new abilities working together with communication professionals.
Lectures are gradually adopting a format that resembles entertainment. Students are inclined to a decentralized consumption of information as opposed to the classic model of confined education, whereby an instructor broadcasts information to a group at a determined time and in a determined physical space.
In future work we will conduct experiments with other videoconference technologies available for the Internet, like for example: Microsoft's NetShow or Real's RealFlash—that permits the inclusion of graphic resources in the videos—and White Pine's new software, ClassPoint, designed specifically for educational purposes.

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Personalizing the Web through Interactive Content-based Indexing

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Abstract: The Dynamic User Searchable Index Engine (DUSIE) provides facilities allowing users to add structure and content to existing web resources. Users are able to create an evolving, user centered concept structure by defining a link metastructure for access to resources and are able to enhance content through annotations. DUSIE provides a means to organize and augment existing resources with a personalized view of the contents.

1. Introduction

The World Wide Web provides open accessibility to an unprecedented amount of information. While the promise of Web hypertext documents lies in the ability to produce richly connected, complex, cross-referenced bodies of information, in reality, documents often become a cacophony of information, which confuses both author and reader. There are no simple organizational schemes in Web hypertext which serve as ubiquitous and commonly understood paradigms of navigation and location [Fowler 97]. In particular, the static nature of most html documents and the relatively limited indexing and navigation mechanisms of the most widely used browsers do not realize the potential for general hypertext systems.

2. Facilities for Organization, Navigation, and Retrieval

Current facilities for the organization and retrieval of information from web documents are limited. Bookmarks, perhaps the primary tool supporting the organization and retrieval of information, draw the user's focus to the page rather than to specific content. The user must continue to search for the desired information. Even when using organizing structures like hierarchical bookmarks, users may not be able to display content in a way that makes sense in a particular task. All in all, the context of bookmarks is removed from the original intent.

While browsers provide numerous ways to navigate through web documents, including hyperlinks, menus, toolbar buttons, location boxes, and directory entries, most facilities require users to have knowledge about the location of information. They do not provide for content-based access to information. While sites or pages can be saved and revisited, the focus is the site or page and not the content. This type of location-based navigation, browsing, and information retrieval is effective for small hypertext systems. For large information-base systems like the Web, information retrieval through navigation and queries is crucial. Content search techniques where nodes and links are treated independently and examined for a match to a query can be extended to the web [Beeri & Kornatsky 1990]. Use of structural queries has also been suggested. Specified terms are used to retrieve edges, paths and cycles. The retrieved objects are collapsed into a hypertext network and users incrementally compose queries [Fowler 1997].

Bruza [Bruza 1990] suggests a different approach to content-based structuring of hypertext document content. His approach uses a two-level architecture for hypertext documents. The top level "hyperindex" contains index information and the bottom level "hyperbase" contains content nodes and links. The hyperindex consists of a set of linked index nodes, each of which contains a descriptor term. Each of the nodes, and subsequently the terms, is associated with information objects in the hyperbase. When an index term node describing the required information is found and selected, the information from the underlying hyperbase is retrieved for examination.

3. A Tool for Ordering Content and Creating Structure

Most of the widely used tools for accessing Web documents do not provide either a sense of overall relations among documents or facilities for the user to impose a structure unique to his/her view. Facilities supporting active engagement by hypertext readers are among the functions characteristic of second-generation hypertext systems. Halasz [Halasz 1988] identifies dynamic, or virtual, structures and extensibility, or tailorability, as important components to be addressed by hypertext systems. Users should be able to move through the system according to their needs without spatial or conceptual disorientation. Users should be able to 1) organize content in a meaningful manner by adding user-defined relations between and within documents, 2) extend the information by adding user defined content to existing web documents, 3) display html and user defined content in a task oriented manner, and 4) reduce cognitive overhead by allowing the users to define their own indices, using their own terms, based on their own understanding. Facilities providing these functions should allow users to focus on the information in a manner that makes sense for their particular task rather than on the extraneous details associated with the information.

4. Dynamic Searchable Indices

The Dynamic User-created Searchable Index Engine (DUSIE) is a user-created dynamic open indexing system, which can connect to other information resources and provides the sort of functionality suggested above for augmenting Web structure. Users construct a personal view of the web or a personal repository of concepts/information and concept/information relations to compliment the existing web structure. Users create alternatives to the static link structure of web documents. Annotation facilities allow the user to extent and/or modify content by 'posting' a note on a web page. With annotation facilities and the additional ability to cross-reference, the index is often more relevant to the user than an index created by the author.

While Web documents use a static and explicit model of hypertext, i.e. nodes, links, and link markers are fully enumerated during creation, DUSIE allows the user to create a virtual structure or model of web hypertext through a user defined indexing scheme. The virtual structure, or user-defined index, has two levels: the index term level with annotation capabilities and the hypertext base level. The index term level is made up of a set of index entries. Each entry consists of term descriptors or keywords supplied by the user, locators (points of interest in a document), and 'posted' annotations. The keywords are as general or as specific as desired by the user and there is space for the user to add comments to the terms. Any particular keyword provides a focus for a set of related concept descriptors and thus a broadening or refinement of the concept represented by the focus index term. The keywords and the set of related concepts then create a structure that can be used to support query by navigation - navigation through conceptual space. In turn, these indices provide immediate access to required information without navigating through the document space.

When using DUSIE, the user defines term descriptors or keywords, and new index term nodes are inserted into the index level. Links are made from the index term nodes to user specified locations in the hyperbase - hypertext documents. Annotation facilities allow the user to add comments to the keywords themselves and to post notes pertaining to the web document content. The later annotations appear as post-it notes and are placed on the document by the user in the desired location. As new index terms are defined and links to the hyperbase are created, content relationships are defined through lists of keywords and implied by overlapping use of keywords. This creates a set of index entry nodes linked together through explicitly and implicitly defined relationships. It is assumed that the user perceives relationships among terms included in a single keyword list and among content areas indexed by the same keyword. As the users' perceptions of the content materials change, users can modify the index term network by adding or deleting links between keywords and links between the hyperindex and the hyperbase.

5. Displaying the Index and Related Information

DUSIE's user interface is composed of a collection of components and provides for multiple views of the user defined indexing scheme and web based information. There are two basic type of components: those that provide extensive interface services such as providing the various user views, and those components that are placed directly on a web page, like the post-it notes for annotation.

The interface appears as a two paned window. Components providing index view services are placed in the top, tabbed pane. The views include keyword list, keyword tree, and keyword graph views. The current web page is displayed in the lower pane. Figure 1 shows a typical DUSIE window with a keyword view of a user index in the top pane and the selected web page in the lower pane.

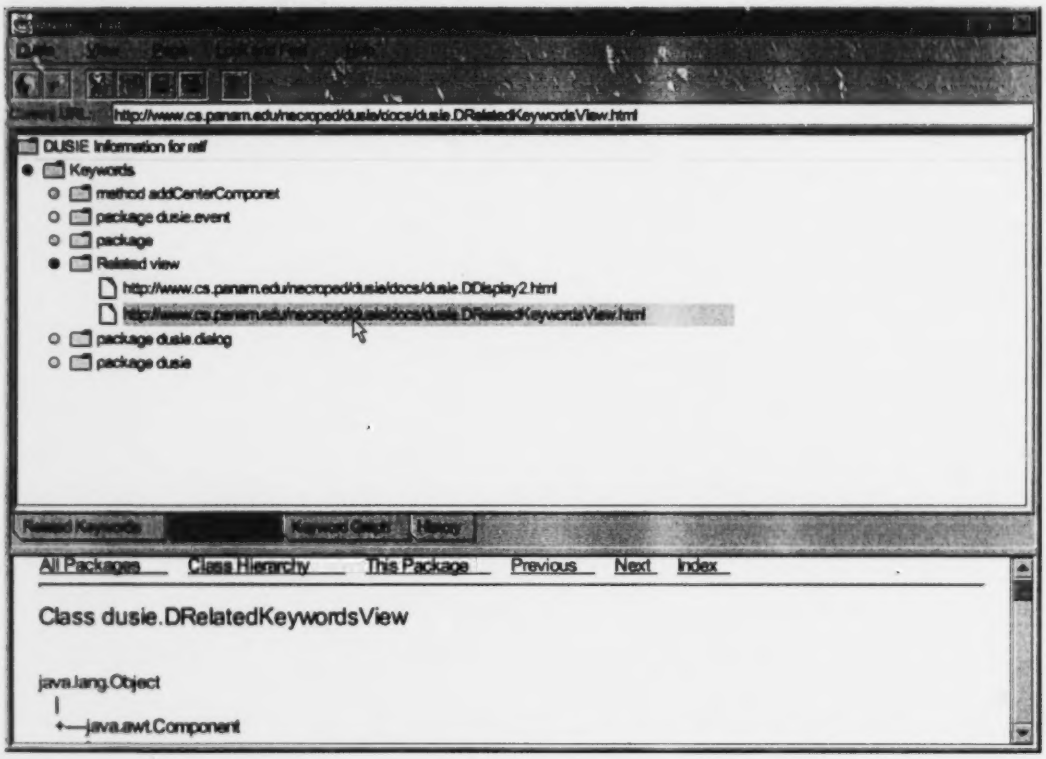

Figure 1: A DUSIE window displaying an index visualized through the keyword tree and the area of the web page associated with the selected keyword entry.

The user can switch between view components by clicking on the appropriate tab on the view pane. The keyword list component simply lists a collection of keywords associated with the current web page. The user can double-click on a particular keyword to be taken to the specific location within a web page in which the keyword is relevant. The keyword tree component provides a list of all of the keywords used by the current user and allows the user to see keyword relationships between pages. In the figure above, for example, we see that the keyword phrase "Related view" is associated with two individual web pages. The user can quickly jump to one of these two pages by double clicking on the appropriate web page icon.

With increasing use of visualization techniques in the presentation, retrieval, and navigation in information space, the keyword graph provides a view of user defined and implied relationships in the information and allows for easy navigation through concept space. The principle visualization is a network display of the hyperindex. The keywords are viewed as nodes of the graph using tools developed

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for general display of web document relations [Fowler 1997b, Fowler 1996, Fowler et al. 1996]. User defined relationships between nodes appear as edges. The nodes and edges provide information about the user's perception of the information and their imposed ordering. Information may be retrieved directly by selecting a node, or the information space can be browsed using the graph structure.

Currently DUSIE supports only one user interface component that can be placed directly on the web page and this is the post-it note component. This component can be placed anywhere within a particular web page and allows the user to annotate a web page. The post-it note component remains, reappearing on marked web page until the note is removed. Figure 2 shows a keyword view of the index with a note posted to the associated web page.

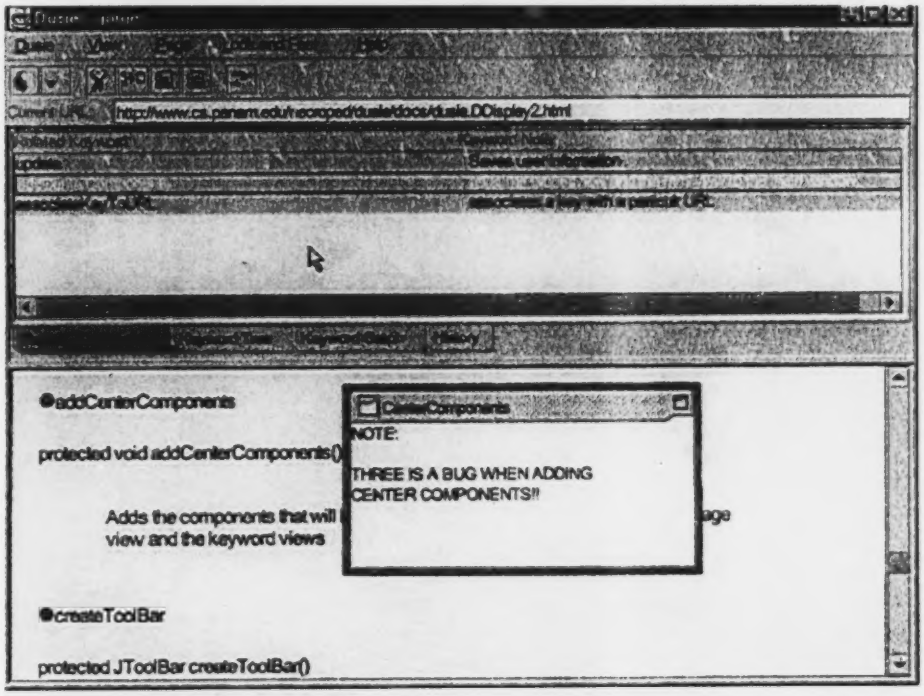

Figure 2. DUSIE display showing the related keywords view and the associated web page with note posted to a user specified location.

6. Implementation

Though the indexing scheme incorporates a two level model, the implementation of DUSIE uses a three level architecture: the information resource, the index application that creates the user defined conceptual structure, and the user-interface client. The actual application is a collection of paired agents: an agent which is defined for a particular task and an agent which is defined for a particular user. The first of these two agents, the task agent, resides in the client machine and is specialized in a particular task, such as a student learning task or web page editing task. Its main responsibility is to provide a user interface that is appropriate for the task at hand. Because it is possible for several task agents to share similar features, i.e. the ability to place a note on a web page, it is also responsible for sharing its user interface components as well as allowing the user to add miscellaneous components (or tools) to the current interface. These miscellaneous user interface components can provide additional visualizations of user data and allow the user to search and interact with his data in a manner that is appropriate for whatever he's trying to do. In our current implementation we make a distinction between two types of

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user interface components: those that can be placed directly on a web page and provide simple functionality, such as the post-it note component, and those that provided extensive user interface services, providing the various index views.

Another responsibility of the task agent is to load the user agent. This is typically done at task agent start time. Unlike the task agent the user agent can reside in either the client machine or any http server. An individual user agent is identified by supplying the task agent with a user agent name (which can be thought of as a user login), a password, and an URL describing the agent's location. A user agent is responsible for maintaining user data, for informing interested components of changes in that data, and for serializing the data so that it can be stored on file or sent on a network stream. Because of the possibility of interaction with miscellaneous user interface components the user agent must be able to store and serialize arbitrary data related to these components.

7. A Multi-Use Tool

As a query tool for information retrieval, DUSIE provides content retrieval through navigation in a manner similar to Bruza's two-level architecture for hypertext documents using a top level containing index information and a bottom level containing content nodes and links. In the DUSIE implementation the hyperindex is a set of user-defined indices linked together. When an index term describing the required information is found, the objects from the underlying hypertext document base are retrieved for examination. After selecting an index term, the specific information associated with the hypertext base link is displayed in a browser. Any posted annotations are also displayed in the browser. Information may also be retrieved through any of the views described above. Thus, DUSIE serves as a navigational tool through conceptual space. The user can move directly to the desired information as well as access related information without having to remember locations, links or other structural details.

In a learning environment, users can add notes to content, i.e., annotate content. Learners can establish links between different content modules: chapters, assignments and content materials/theoretical materials/ establish links between theoretical materials and concrete application of concepts. Learners are able to establish their own organization of materials - either by superimposing a different organization (link structure) or by enhancing the existing link structure. The tool reinforces learning through the active construction of an associative network of terms and annotations. Students can define an index that explicitly defines their understanding and use of concepts. They can impose their own relationships on the information and modify their ordering as their perceptions change. The index reflects the learner's conceptual domain and can be used to retrieve information efficiently.

In web editing, editors can scratch out or underline parts of html text. The editors can leave notes for the developers (e.g. "I can not view this using Internet Explorer"). While b*rowsing documentation*, notes may be made concerning changes in different parts of the code. The developer can make notes about errors and necessary modifications.

For groupware, web documents can be a useful tool for exchanging and developing ideas. The usefulness can be increased by making the documents multi-user and interactive. Using the annotation facilities, participants can not only browse the document, but also provide commentary on the document that can be stored back to the server and shared with other similarly privileged participants. Carrying the interaction one step farther, participants can annotate the annotations, supporting a dynamic project development and management.

8. Conclusion

DUSIE provides mechanisms that allow users to create, modify, and save an annotatable index for the web. The functionality allows the user to construct a personal repository of concepts (information) and concept relations (information relations) to compliment the existing web structure. In essence, users define their own extensible hypertext that evolves as their understanding of content, information needs, and tasks evolve.

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The Effects of Error Management, Exploration, and Conceptual Models on Learning to Use the Internet

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Abstract:

When novice users learn new computer tasks, they frequently make errors. These errors tend to frustrate novice users, who may not be able to recover from the errors. The research literature has defined three methods for training novice users to respond to errors: error management, exploration, and conceptual models. This short paper describes an experiment-in-progress that is testing the effects of error management, exploration, and conceptual models on novice users learning to use the Internet.

Introduction

Novice users frequently make errors when learning a new computer task [Greif & Keller 90; Lazonder & Meij 95; Norman 83]. Novice users spend a large portion of their time trying to recover from errors [Carroll & Carrithers 84]. When novice users learn tasks in a networked environment, such as the Internet, the probability for making errors increases [Lazar & Norcio 98]. These errors are stressful and tend to frustrate novice users [Arnold & Roe 87]. Furthermore, traditional training methodologies for novice users focus on avoiding errors, by providing users with a step-by-step list of how to perform a task (this is also called "procedural training") [Carroll 84; Frese & Altmann 89; Wendel & Frese 87]. Users are expected to follow the steps exactly, to avoid making errors. Not only do users have problems following steps exactly, but this method does not realistically model their work environment [Arnold & Roe 87; Carroll 90; Greif & Keller 90; Lazonder & Meij 95]. Errors occur frequently in the workplace and users need to be prepared to deal with them.

Responding to Errors

Three methodologies for helping novice users respond to errors have been presented in the literature: error management training, exploratory training, and conceptual models. In error management training, errors are presented as opportunities for learning [Dormann & Frese 94; Frese & Altmann 89; Frese et al. 91; Nordstrom, Wendland & Williams 98]. In error management training, users are instructed in strategies for coping with errors. In exploration, users are given an overview of their environment [Greif & Keller 90; Wendel & Frese 87]. Instead of being given step-by-step directions, users are taught how to navigate through their task environment. Conceptual models are graphical or mathematical representations of a system that correspond closely to the real-world system [Santhanam & Sein 94]. Conceptual models assist users in understanding systems, and predicting the actions of systems.

Current Experiment

We have created a research framework, which shows that there are many possible approaches to training that have yet to be explored. Furthermore, most of the published literature focuses on the user application of word processing. There is a paucity of published research focusing on user errors in network-based applications such as e-mail and web browsing. The goal of our study is to learn more about the effects of error management training, exploratory training, and conceptual models on learning to use the Internet. Based on our research framework, we will test the effects of eight possible approaches to training novice users to use the Internet. After training sessions, the subjects will attempt to perform ten tasks on the World Wide Web. Our study will measure user performance in two forms: the accuracy of task performance and time needed to complete the tasks. The number of errors will not be measured, as what constitutes a user error in the networked environment is not well-defined [Lazar & Norcio 98]. After attempting the tasks, subjects will fill out the Questionnaire for User Interaction Satisfaction, a standard tool that has been tested and validated in the

literature [Harper, Slaughter & Norman 97; Norman et al. 98]. By the time of the WebNet 1998 Conference, we expect to have preliminary results from our experiment.

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A Secure Web-based Video Conferencing

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Abstract : The Web enlarges its applicable area such as existing internet services using Internet, including new services. With the advent of new technologies, such as ActiveX contro!, Java applet, Java Beans, dynamin HTML, and client/server-side script and so on. The use of web-based application will be increased continuously. Currently video conference is even based on the Web. Until now, users who want to participate in video conference has to install a specific software on their computer. Now, Web browsers can be used for multipoint video conference. In this paper, we introduce a secure video conferencing system which is being prepared.

1. The Problems

The Web has has a serious problem with security. To serve the problem, many researches have been conducted. With the result of studies, useful methods to solve the problem have been proposed and are being used. In the area of authentication, password verification method is widely used. But the password method still has some problem in security. So we should consider more secure method such as [LEE & KIM 97] based on [Diffie & Hellman 76]. The server, however, has to maintain ACL(Access Control List) like the password method. If we consider the video conference, we can reduce the size of ACL considerably.In the video conference, the number of passive users(participants) is much more than of active users(chairman). For instance, suppose that there are 100,000 employees in an organization. There is no case that all of them would need to be chairman of video conference. Because of the reason, we just maintain ACL for 6,600 active users if there are 15 participants per conference on an average.The server can authenticate passive users by temporary key that is issued by the server itself.

2. SVCC and SVCM

The Secure Video Conferencing System consists of 4 software components, VCSA(Video Conferencing Service Application), SVCC(Secure Video Conferencing Component), VCSM(Video Conferencing Server Manager), and SVCM(Secure Video Conferencing Manager). Among these, SVCC and SVCM is being developed as ActiveX controls, VCSA and VCSM is being developed using ActiveX control for video conferencing with JavaScript/VBScript. Figure 1 is a snapshot of SVCM prototype.

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Figure 1. Prototype of the SVCM

2.1 Conference Registration Phase

Only the chairman can open conferences. Receiving conference reservation request from the chairman C, the server authenticates C using authentication method [LEE & KIM 97]. If the chairman C is valid, the server sends hints H_{P1} and H_{P2}, which are used to calculate temporary access keys for participants P_1 and P_2.(see figure 2)

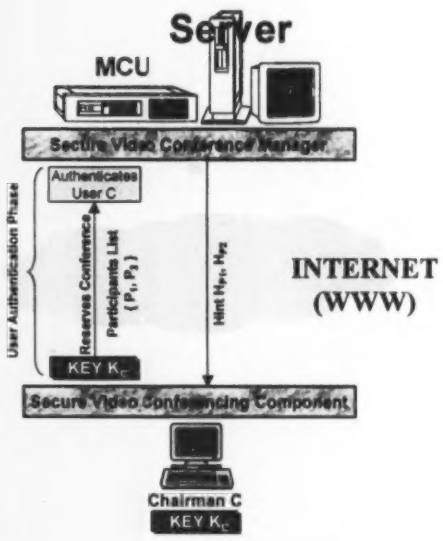

Figure 2 : Conference Registration Phase

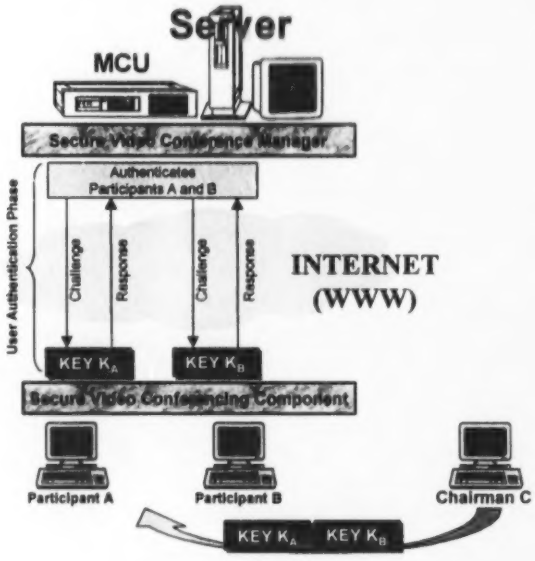

Figure 3 : User's Participation Phase

2.2 User's Participation Phase

After the registration phase, the chairman can produce temporary access keys to be enable other users to participate in the conference. The participants can not use his temporary access keys in order to participate in other conferences.

3. Conclusion

The Secure Video Conferencing System which is being developed by Korea Telecom, will be served for end users by the end of this year. As the system can be operated over the Web securely, end users do not need to install any softwares. This project is in progress. The results of this project will be presented at the conference.

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Attitudes and Practices of Educational Technology Among Preservice Secondary Students and Their Cooperating Teachers

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Abstract: This study was conducted to gain information regarding the attitudes and practices of educational technology among preservice teachers and their cooperating teachers during the student teaching experience. Two university supervisors and their student teaching teams participated in the study. The results indicated that no significant differences occurred between the two groups when educational technology applications were emphasized. Qualitative evidence suggested that the differences in attitudes and practices actually occurred more as a result of student teaching experiences and the role modeling of the cooperating teacher.

Purpose:

This study was designed to elicit key information from undergraduate education students and practicing teachers about their use of educational technology. For this study, educational technology was defined as "the process of applying tools for educational purposes, as well as the tools and materials that are used" (Roblyer, Edwards, & Havriluk, 1997, p. 5). It was hoped that this information would assist in planning undergraduate and graduate coursework at Morehead State University (MSU) that would better serve the needs of our service region. MSU currently requires two educational technology courses in the Teacher Education Program.

The attitudes and practices of these groups is essential to understanding the teaching of secondary school children (Hall & Hord, 1987). Kentucky has recently pushed ahead efforts to place educational technology tools into its schools. Internet access for all schools has been targeted for August 1998; computers and other equipment have become commonplace. However, widely varying differences in the types of technology and its applications exist from school to school even within the same system. It is important to determine if these differences are attributed more to training, personal beliefs, or equipment availability.

Problem Statement:

How do the attitudes and practices regarding educational technology of preservice teachers (student teachers) differ from those of cooperating teachers (inservice teachers) during student teaching?

Description of Methods:

At MSU, student teaching consists of enrollment in two courses: EDSE 415, Teacher in Today's Schools, which is a methods course, and EDSE 416, Student Teaching, a field experience. Student teachers are randomly assigned to supervisors. During Fall semester 1997, EDSE 415 met on campus for two weeks for two hours per day. Following this, EDSE 416 immediately began and ended with the regular semester. EDSE 415 meets at least once more for a mid-term conference, but the sessions can be scheduled at the instructor's discretion.

Two of the three secondary student teaching supervisors participated in this study. Group One was the experimental group. The instructor delivered specific educational technology and facilitate its application. Group One initially contained eight preservice teachers and eight cooperating teachers. On the third day of the semester, another student from Group Two was transferred into Group One. The Group One instructor was a proficient PC and Macintosh user with experience in developing educational technology competency. Group Two was the control group with fourteen preservice students and fourteen

cooperating teachers. They received normal instruction expected of EDSE 415 and EDSE 416. The Group Two instructor was a proficient PC user.

Throughout the semester, Group One received training in computer applications such as ERIC search and photograph scanning programs, used electronic mail, and participated in everyday classroom exchanges through an interactive web site, NICENET, (http://www.nicenet.org) on a regular basis. A digital portfolio, a dynamic presentation of the interview portfolio demonstrating successful completion of Kentucky's New Teacher Standards, was created using PowerPoint and was then burned onto a CD-ROM. All educational technology activities were assigned as part of EDSE 415. Members of Group Two received no computer training nor were they required to participate in any educational technology training or applications.

On the first day of the semester, preservice teachers in both groups were asked to complete a survey regarding their attitudes and practices of educational technology. Surveys were mailed with return reply envelopes to cooperating teachers at their schools on this date. On the last Monday of student teaching, the same surveys were mailed to preservice teachers at their homes and to cooperating teachers at their schools. Return reply envelopes were also included for their responses. A digital portfolio survey was also given to Group One after project completion asking specific opinions on educational technology, the digital portfolio, NICENET, and equipment use.

Report of Results:

Unfortunately, preservice and cooperating teaching respondents from Group One and Group Two showed no significant differences in either the pre-survey or post-survey variables. The groups were combined for statistical analysis of the ordinal general questions. Reports of descriptive questions regarding attitudes about educational technology and classroom practices do show differences among preservice teachers in the two groups, but not cooperating teachers. Group One preservice teachers were much more responsive with specific classroom applications for educational technology in the post-survey. They detailed the kinds of equipment and software that they might use and provided some Internet site information. Group Two preservice teachers continued to have the same attitudes and practices as before the student teaching experience. They had no specific applications for educational technology. In fact, those responding indicated a hesitancy to use the technology of any kind.

Preservice teachers were predominantly 21-25 years and female. Six of those responding were seeking English certification, three social studies; seven identified themselves only as "secondary." Mathematics, vocational education, foreign language, science, and art were also represented with one person each. An overall return rate of 91% was observed in preservice pre-surveys and 26% return for the post-surveys. Cooperating teachers were primarily 26-30 years of age but did range to 50. Respondents in the pre-survey were predominantly female; post-survey indicated more male responses. Overall, more English and mathematics cooperating teachers responded to this survey. Cooperating teachers had a return rate of 25% in the pre-survey and a 13% rate for the post-survey.

Most interesting were the findings regarding classroom use of educational technology. All cooperating teachers reported in the pre- and post-surveys that they did use educational technology in their classrooms. All preservice teachers also stated this in their post-surveys. The ways in which the educational technology was used by cooperating teachers seemed to focus on the teacher, not the student. Cooperating teachers reported in both surveys that they used computers to word process, maintain classroom attendance, grade book, and "check the weather." Some cooperating teachers stated that students used specific programs to create school newspapers, banners, and for remediation. Most often, student use was relegated to "word processing for portfolios." Preservice teacher use of educational technology also reflected a teacher-centered approach, although at least two respondents claimed to have incorporated computer searches for topical information. One respondent stated that he had demonstrated a math skill with a graphing calculator, another responded that students word processed only.

It is essential to follow-up this paragraph with the results of the open-response questions. Prior to student teaching, all of the preservice teachers regarded educational technology as a necessary component of teaching. After student teaching, though, the attitude changed dramatically. They still believed that educational technology was essential for students, but access to that technology greatly compromised any gains to be found. Take for example the statement of a Group Two preservice teacher, "I've seen it take three days to allow every student in sophomore class to get to use the computer. . ." A preservice teacher in Group One stated that she felt pessimistic about technology applications " . . . because I was in one of the bigger school systems and if it can't happen there (computer access for students), then it probably won't

happen in the majority of places." Cooperating teachers phrased the problem succinctly. Group One respondents wrote, "It isn't fair for just a choice few to be able to use the computers in my classroom," and, "It would be good if every student in my classroom has access to a computer, but I only have two." A Group Two respondent stated that "it needs to be used more, but money to get technology most of the time is not available."

Training and practical experience in educational technology, apparently, is also lacking for preservice and cooperating teachers. A Group Two cooperating teacher commented in the post-survey that she "did not use computer labs" because the lab operated on an unfamiliar program. Yet, this person claimed to have had several professional development days in computer programs training. In the pre-survey, preservice teachers claimed that they had had some experience in electronic mail, the Internet, and word processing. Group One respondents made the following statements:

"I feel that if I had been introduced to more ed. tech. that I would be better prepared to teach," "I never had computers or anything like this when I was in High School so it took me longer to get computer friendly," and ". . . I have found myself at a disadvantage in the past because I was not familiar enough with e-mail, (Inter)net, (and) computer use. It was frustrating and once I was forced to get involved, I felt better."

Importantly, after student teaching, a respondent from Group One summed the group attitude in these comments about educational technology, "This program (digital portfolio) had a very positive effect on my student teaching semester. As I went through the steps of designing, I honestly became more interested and amazed at the capabilities of computer technology."

Additionally, respondents were asked several general questions pertaining to their actual possession of or access to educational technology tools. These questions were used to develop an understanding of attitudes toward technology as well as whether or not access was increased after student teaching.

Pre-survey results showed that 33% of preservice teachers claimed to own a personal computer. Nearly 14% of them used the computer at least two to three times a week. Cooperating teachers (83%) reported that they owned personal computers and used them two to three times a week (40%). In the post-survey, 75% of preservice teachers owned a personal computer; 100% of the cooperating teachers. Preservice teachers (50%) claimed to be using them every day; cooperating teachers (67%) reported doing so. Interestingly, all preservice students and cooperating teachers reported owning either a PC or PC clone.

Word processing, "Internet," "games," and electronic mail were the most frequently noted computer uses both in the pre- and post-survey. Several (23%) preservice and cooperating (20%) teachers stated that they did have electronic mail at home, but all pre-survey preservice respondents cited having access to electronic mail accounts through MSU. The post-surveys indicated that 50% of preservice teachers and 33% of cooperating teachers had electronic mail at home. No preservice teachers had an account through their work sites, but 75% of these cooperating teachers did have an account through their work sites.

Respondents were also asked about their specific use of the Internet. Pre-survey responses showed that 52% of preservice teachers and 67% of cooperating teachers were "surfing the web" once a week. Post-survey results were evenly
distributed among once a week, two to three times a week, and every day. In the pre-survey, 76% of preservice teachers indicated that they used the Internet in "research for a class," 67% for "personal inquiry," and 52% for "lesson plans." Meanwhile, 67% of cooperating teachers were using the Internet for both "personal inquiry" and "educational interest." Results of the post-survey displayed an even distribution among "personal inquiry," "research for a class," and "educational interest" for preservice teachers and "research for class" and "educational interest" for cooperating teachers. Less than 10% of either preservice or cooperating teachers stated that they had used a particular web site in the planning of lessons in the pre-survey. Cooperating teachers did not respond to this question in the post-survey, but 67% of preservice teachers claimed to use specific web sites.

Conclusions and Implications:

Evidently, preservice teachers feel a lack of knowledge about the general use and application of educational technology. Despite any claimed knowledge of educational technology, cooperating teachers in their student teaching experiences will set the tone for teaching practices, at least during the field experience. Preservice teachers were eager enough to use educational technology until they student taught.

Cooperating teachers are using educational technology to the best of their abilities and trying to make it accessible for all students (Kishi, 1997). Some were quite interested in the use of technology for personal reasons and management of school record keeping. Unfortunately, the marriage of theory and practice in the use of educational technology for these preservice teachers has hit a rocky patch. The preservice teachers, lacking realistically based knowledge of classrooms and school operations, rely on the expertise of their cooperating teachers to guide them through the use of educational technology. Cooperating teachers are mucking through very slowly and, in some cases, ill-prepared.

Preservice teachers in Group One have shown an increase in the positive attitudes toward use of educational technology for personal use in the classroom. At least one of the respondents has purchased a home scanner and plans to explore other technology. Two others have stated an interest in using more technology for graphics purposes. However, since the results indicated that preservice teachers are more influenced in their use of educational technology in the classroom by their school environments and cooperating teachers, it would do teacher education well to require more educational technology applications, general program understanding, and classroom practice in all of its courses. Once teachers gain this information, classroom use will become second nature. Without university intervention, many teachers would likely shun its use and foster the same in preservice and beginning teachers.

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Using Java and Dynamic HTML to Develop Collaborative, Computer Assisted Learning

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Abstract: The construction of a very fast network backbone between all Scottish universities in conjunction with the formation of a common core curriculum, provided the medical schools with an opportunity to provide collaborative, computer assisted learning across the World Wide Web, delivered by a central site. Thus computer assisted learning, embracing the latest technologies of Java, Dynamic HTML, Javascript and MPEG-1 video, was successfully developed and implemented in the form of interactive, multimedia Model Patients. This paper will present our development, design and delivery issues, what methods we used to address them and report on student user experiences to date.

Introduction

The Child Health Medi-CAL project is the product of the convergence of new pedagogical policy with the emerging Internet technology.

Background

As a result of the General Medical Council (GMC) guidelines [GMC 1993], the medical schools teaching child health in Scotland founded a Common Core Curriculum to enable sharing of teaching resources and materials. The fact that much of the material is relevant to child health training for nurses provided an opportunity to collaborate further.

The GMC guidelines also encouraged the introduction of IT learning resources, which lead to the choice of the World Wide Web (WWW, W3, the Web) as an ideal delivery medium for Computer Assisted Learning (CAL) to supplement the curriculum [Robinson et al. 1998]. This would allow one center to serve all the medical schools in Scotland.

The Scottish Higher Education Funding Council (SHEFC) is committed to supporting the infrastructure for this type of collaboration. Delivery speed for this kind of material is crucial, especially for downloading large video files and to address this SHEFC have funded a very fast 155Mbit/s fiber optic network backbone between the main academic institutions of Scotland. To encourage use of this Metropolitan Area Network (MAN), SHEFC offered funding for projects which would be effective and innovative in their use of the available bandwidth.

The maturation of browsers into sophisticated multimedia presentation devices and the arrival of the WWW programming language Java, and Dynamic Hypertext Markup Language (DHTML) allowed the creation of fully interactive multimedia applications. There was also the advantage of having potentially nothing to install onto the computers to be used. The resource could then be completely centrally administered without requiring to give notice of upgrades, errata and additional applications.

The Aberdeen University CAL Unit has extensive experience in producing software in the form of "Model Patients" [Hamilton et al. 1998]. These applications supply information in a multimedia form with text, sound, images and video, which is also interspersed with questions and decisions allowing the students to interactively manage a patient's illness, a task which cannot be readily achieved in traditional forms of teaching.

The CAL Unit is therefore well placed to tackle the above project by producing similar Model Patients on the Internet using DHTML and Java. It is also able to give clinicians carte blanch to conceive new innovative forms of interactivity to simulate real life decisions and responses which clinicians make.

Summary

We are contracted to construct 30 multimedia Model Patient applications delivered by a WWW server using the latest Internet technology (Java, DHTML, MPEG-1, etc) over a period of eighteen months. These were aimed at undergraduate medical and nursing students.

The scripts and multimedia used to produce the learning material in the applications were provided by clinicians from all of the collaborating institutions.

Materials and Methods

World Wide Web

The need to deliver model patients to all the universities in Scotland, resulted in the WWW becoming the obvious choice as the delivery medium, reinforced by the development of the ultra wide bandwidth offered by the Scottish academic MAN.

WWW is a distributed information retrieval system on the Internet that places the information in multimedia hypertext pages which are downloaded and viewed in web browsers (such as Microsoft Internet Explorer and Netscape Navigator). It has the advantage of being independent of network topologies and client operating systems allowing one version of the applications to serve all universities, no matter what hardware/software their IT strategy implements.

WWW hypertext pages were originally static and passive, only *displaying* information, not allowing any user interaction other than choosing which hyperlink to follow. Although Model Patients could feasibly be developed using this technology alone, the result would be crude, cumbersome, slow to respond and very limited in its diversity of interaction.

The advent of forms and server-side Common Gateway Interface (CGI), scripting using languages such as Perl, offered improved functionality, allowing several kinds of interaction. Unfortunately the user still has to wait for the server to process the choice and respond to the user which, during network congestion, can be slow and frustrating, and can therefore discourage usage. Diversity of interaction is still ultimately limited to what can be implemented using forms.

Java

Around 1995, Sun Microsystems developed a new Object Oriented (OO), distributed, secure, architecture-neutral, interpreted computer programming language called Java. Originally aimed at imbedded programming in consumer devices, it became apparent to Sun that the language was ideally suited for applications on the WWW thereby inserting unlimited interactivity into HTML pages. Application Programming Interfaces (API's) were added to the core library for Graphical User Interfacing (GUI's) and TCP/IP networking. Design constraints had the priority of platform independence and robust built-in security.

Java is therefore a very powerful tool for producing CAL. As a programming language it offered full control of CAL design supplemented by inherent qualities of OO and multi-threading. Small applications called Applets can be imbedded into web pages to provide any form of interaction the developer desires. The GUI allows Human Computer Interfaces (HCI), facilitating user interaction, to be quickly and easily developed. The networking API allows server side communication for centralized auditing and logging.

The CAL Unit immediately embraced this technology and subsequently, the original interactions (multiple-choice questions, multiple-answer questions, true-false questions and interactive image maps) provided by the

legacy stand-alone software, were quickly emulated and improved. A modular approach was adopted, creating one applet for each type of interaction. This negated the problem of extensibility, a limitation of the original large software engine, as new types of interaction could be easily added at any time by simply writing a new applet and plugging it in. This would not interfere with the existing software. This approach had the advantage of easy debugging, due to smaller size and complexity, and a new applet could be written without any knowledge of the existing applets, thereby accelerating development.

Applets were designed to be as generic as possible taking, parameters from the HTML pages for such information as the number of answers, the text for each answer and whether it is correct, response for the answer, image map target coordinates etc. By creating custom GUI components with built-in features such as automatic text wrapping, the user interfaces were designed to present varying numbers of answers and lengths of answer text. Object Orientation was extensively exploited and a series of sub-modules (classes) were written and re-used throughout the applets to save code replication and provide a similar look and feel throughout.

Due to Java's properties as a full blown programming language, clinicians writing scripts for the Model Patients have been encouraged to conceive innovative, new forms of student interactivity to further put students into realistic problem solving situations. One idea is allow "multiple outcomes" whereby the possibility for student to misdiagnose or prescribe the wrong treatment is a valid option and the scenario is followed through to its conclusion.

Java is a rapidly developing programming language and since the project started a new version (1.1) has been released by Sun. This version contains several improvements that were thought to be useful to the project. These include:

- A much-improved event model to detect user input etc making lightweight components far easier to write.
- Archiving and compression of class files – Java Archive (JAR) files which decreases the number of requests the client makes to the server and the amount of data to be downloaded, thereby decreasing download time. The perceived performance increase makes the applications much more user friendly and usable by students.
- Just In Time (JIT) compilers dramatically increased the speed of execution of the code. This allows the potential of very complex applets with intensive calculations which could be used for "on the fly" simulations etc.
- The use of encryption and certificates to upgrade Java's security model to allow applets to write to local clients' hard drives which was previously forbidden.
- Java Beans – reusable software components that developers program which can subsequently be manipulated visually using application builders. These could allow rapid application development by non-programmers to extend the applet set. This has yet to be fully investigated.

It was deemed necessary that there should be a dynamic record kept of all pages visited by the student. This ensures that pages, which should be more appropriately visited *after* visiting preceding pages in the Model Patent, could not be accessed without warning. This would be bypassed by a review option. It was feasible to use the new security model to implement this, by updating a log file on the local disk.

However, the additional administration involved in the installing of public encryption keys and certificates in the trust library of every computer requiring to access the applications, prohibited this route. Instead a server-side application was implemented, which communicates with applets imbedded in the web pages, keeping a log file listing the visited pages, on the server for each client. Thus the goal of central administration is preserved.

This additionally provides the user with a history utility which displays the pages previously visited by the student and allows them to directly navigate to each of those pages.

The implication from Sun that future versions of Java would not be compatible with the previous versions to 1.1 led to a decision to write the code to target the latest version. This has tied anyone using the resulting applets to using 4th generation browsers (such as IE 4 and Netscape 4) as previous generations did not have a Virtual Machine (VM) which was 1.1 compliant.

Dynamic HyperText Markup Language

A spin-off from the 4th generation browsers presented itself in the form of a new technology called Dynamic HTML (DHTML) DHTML is a term used to describe the interaction between HTML, Cascading

Style Sheets (CSS) and scripting languages such as Javascript. In essence DHTML builds on the static nature of HTML by allowing authors to specify the exact position and style of elements within a web page. This contrasts with the previous model whereby individual browsers were tasked with information presentation based on a set of guidelines. In addition the web page elements can be further manipulated using scripts. Parts of a page can for example be hidden from the user until either a mouse enters a certain area of the screen or a mouse button is clicked.

DHTML offers far more control over the look and feel of the Model Patients enabling them to seem like custom applications rather than HTML pages in a browser. It has therefore been used to address many design considerations. To standardize the look and allow faster and more intuitive development of the pages, CSS's were implemented to have separate divisions in which text and components were then dynamically formatted, coloured and positioned on the page.

We had to consider the screen resolution that students would be most likely to use. This was determined to be 800x600 pixels. We subsequently decided to target our design of the pages to this resolution and to eliminate any need for scrolling at this selected size. To reduce perceived download time and create emphasis on certain points, specified words are given links to text or image panels that are hidden on the page. When the mouse passes over these words, the panels are then made visible and positioned dynamically. This was found very effective for presenting images, summarizing key points and providing optional or expanded information - all within the desired page resolution.

To allow the pages to look and feel more like a custom application, a navigation/title bar, placed at the top of every page, was implemented. This contained the title of the Model Patient, the copyright and logo of the funding body (SHEFC) and three interactive buttons that offer functionality to go forwards and backwards through the pages as well as link to a help page.

Additionally, each Model Patient application is given a button in a parent page. The result of pressing the button is an invocation of a script that closes the original browser window and opens a new one at the Model Patient's title page. Since browser controls are superfluous and distracting in this case, we removed them from the window, emphasizing the appearance of a native application and offering more white space for the pages themselves. The navigation bar described above provides the necessary controls.

The browser window was also given a fixed, non-customizable size of 800x600 pixels to force the pages to be rendered in the way they were originally designed, completely eliminating the need for scrollbars with the exception of the use of a screen resolution lower than 800x600.

Results

At this time, the testing of the Model Patients has mostly been limited to Windows 95 and Windows NT operating systems using Internet Explorer 4. Due to the fact that the latest version of Netscape Navigator is not yet sufficiently Java 1.1 compliant, platform and browser neutrality will be addressed upon release.

To test the usefulness and usability of the applications, on-going student beta testing was performed. Groups of four students are split into pairs and asked to use the applications with minimum supervision and encouraged to discuss their experience aloud. Relevant comments were duly noted and appraised.

- The feedback was very positive with the students intuitively navigating the model patients with little or no instruction.
- They enjoyed their experience of the software and intimated that they would readily use the resource if made available to them. They were impressed with the quality of the video and the functionality of the Java Applets.
- Criticisms were aimed at the video instructions that did not explain clearly enough, that they could be played before the download completed. This has now been rectified.
- The difficulty level of some of the material was not considered high enough, this will have to be rectified by the contributing clinicians.
- Download time for the pages was of primary importance to the students in terms of usability. It was considered that if response times were slow this would act as a de-motivator to using the applications. However, during the testing, the universal opinion was that the Model Patients were sufficiently responsive.

Discussion

The basis for implementing the 30 applications is now complete and the desired functionality is fully implemented. Model Patient scripts can now be quickly and easily processed into applications.

Hardware and Software Requirements

The implications arising from the requirement of a 4th generation browser have to be confronted. Most of the universities at this time have implemented the Microsoft Windows 3.x operating system for which there is no adequate browser software available. The browsers will require an operating system such as Microsoft Windows 95 or Windows NT. Windows NT is the favored choice due to the benefit of its inherent security, although this does requires a very high level specification of computer. A minimum suggested specification would probably be an Intel Pentium 133MHz processor (or equivalent) and 32 megabytes of memory.

Fortunately all the Scottish institutions are committed to upgrading the computers, available to students, to run the Windows NT Workstation operating system. This will subsequently allow a robust DHTML and Java 1.1 compliant browser to be installed (such as Internet Explorer version 4.x). This is a difficult and expensive undertaking but will have the bonus of pushing forward the level of computing sophistication available to all students.

Delivery Speed

Delivery speed has been targeted as a priority, since unresponsiveness will discourage usage of the resource and thus has been given due consideration throughout the project.

We are collaborating with the IT departments of all the participating institutions to attempt to ensure that all the students have access to computers connected to a fast network, which itself should be connected to the MAN.

The most likely source of delay is the download of large video files. This is partly addressed by MPEG-1 type videos when viewed by Microsoft's media player. The partially downloaded file can be played while the rest if the file is still downloading. This is only useful when the download speed of the date is at least as fast as the data is played. As simultaneously downloading, uncompressing and playing of the video places a significant demand on the CPU, a high specification machine is required.

The video files were placed on a fast video server connected directly to the 155Mbit/s network backbone via a fast Ethernet interface. As some students may only have access to slower network connections, videos may also be sourced from CD-ROM. To reduce the *perceived* download time we are considering placing a relevant task for the student on the pages where the videos are accessed. This would keep the student busy during the transfer of the video data.

The introduction of JAR files, to incorporate the individual Java class files and compress the data to be transmitted, will reduce the number of requests to the server by the browser and improve download time for the applets, thereby increasing the startup speed for the interactive components.

The loading of images into hidden panels imbedded in largely text based pages, appearing when specified words are moused over, increases the perceived responsiveness since the students should be reading the text during the downloading of the pictures.

Design

HCI considerations for the look and feel of the applications have been carefully thought through and the resultant design has been universally popular. The text was considered to be clear and easy to read with no problems for colour-blind people. Use and navigation were considered intuitive with little instruction necessary.

Conclusions

The use of WWW as a delivery medium for CAL has proved to be both feasible and practical with the provision of high bandwidth networking. Collaboration between institutions allows shared resources to be served from one server leading to efficient use of developers and content contributors and lowers delivery costs and administration.

Tools such as Java and DHTML are very powerful and attractive in the production of CAL when the relevant technical expertise is available to the content providers.

DHTML married with Javascript produces browser hosted web pages with look and feel like intuitive, user friendly custom applications. Design and layout are major considerations for the applications to be popular in use.

Java as a full blown programming language with many programming interfaces bolted on, allows an infinite diversity of user interaction which is only limited by the imagination and programming skill of the developer.

We have successfully used these tools to produce CAL applications, which have been well received by students and clinicians alike. CAL on the WWW is a reality now and will continue to improve with the development of the relevant technology.

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Can Intranet Really Help Local Companies In Hong Kong?

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Abstract: Intranet is a product of recent Internet technology development towards an enterprise network for companies to conduct their businesses. And it has many claimed advantages against some traditional approaches in a business environment. However, how actually a company can, or what kinds of companies will, benefit from deploying intranet are still relatively unknown. Thus, in this paper, we present an investigation of intranet use in Hong Kong local businesses, to find out how exactly intranet is used or applied, and whether they have achieved their planned business goals in this technology shift. Results of this investigation, associated analysis and discussions are also presented in the paper.

1. Introduction

Traditionally, Web associated business uses have mainly been related to marketing functions, i.e. to publicise or promote a company's information, products, or services etc. However, in the last several years, the situation has changed dramatically. Many companies are now conducting their businesses either themselves or with their business partners through the Internet. Even the term "Internet Commerce", has become the buzz word among electronic commerce communities, and is often used in occasions when traditional "Electronic Commerce" was previously used. This phenomenon indicates that Internet is not only widely accepted and used on an individual basis, but people in the business world have gradually recognised the potential of conducting business on the Internet, though many obstacles are yet to be overcome, such as lack of security and limited transmission bandwidth etc.

With the development of applying Web technology on an enterprise network, such as intranet application, companies now have another option to explore and enjoy the power of Internet on a company network. However, how companies cope with these development, and what kind of companies will benefit from these technologies, are still relatively unknown. Thus, in the following sections, we will discuss these issues. Firstly, we provide a general overview of intranet, and its claimed pros and cons. Secondly, we take a look at the current status of intranet uses with special attention given to Hong Kong. Thereafter, detailed investigation and analysis regarding intranet uses are presented in terms of three aspects: technical complexity, operational feasibility, and maintenance and staff training.

2. Intranet and Its Major Uses

Intranet is an Internet communication system that is built by the Web technology using TCP/IP. Internet can also be defined as the integration of all organisation's information assets and communication facilities into a single, widely accessible networked environment which uses Internet-based technologies [Hills 1997]. An intranet system can form as a standalone or closed system which has no contact with the outside world, or it may be opened, which the information inside can be accessed externally when authorised, or vice versa. Either ways, a company can enjoy the many benefits that intranets provide. The decision of whether to close or open a system, is of course subject to each individual company's actual requirements, financial status, and technical capabilities. The inter-enterprise links across the Internet is however the current trend of electronic data interchange (EDI) development [Mkillikin 1997].

An intranet needs to be built on a traditional networking system, such as local area network (LAN), Thus, it offers most of the services that a traditional LAN would offer, and provides more. For example, the services

that we normally enjoy on the Internet, such as e-mail, ftp or telnet, are all accessible on an intranet. Even more significant, with the implementation of intranet, all company's information such as organisation charts, sales report, production information etc., can be standardised on Web page basis, and maintained in various Web servers of corresponding departments, which can be accessed by company employees either internally or externally through a Web page browser. The standardisation makes a company's operation, control and management much easier, more accurate and efficient, and with much enhanced transparency in communications and information sharing among the intranet users.

Intranet also poses potential threat to conventional electronic data interchange (EDI) applications, as current web technologies such as Java and CGI, can be used to create interactive applications. As predicted by King [1997], "electronic interactive applications" will surpass conventional batch and application-to-application EDI by the year 2000. Unlike EDI applications, an interactive electronic commerce scenarios on the Web, will give users more flexibility in finding ways around and things they like including images, graphics, videos, and sound etc. Users can enjoy the interactivity that conventional EDI would be able to offer, though it will take years before seeing significant transition when the reliability and security problems on the Web are overcome.

The above mentioned advantages may be the main reasons that why more and more companies are allured or persuaded to install intranet systems. Especially for those companies who have multiple computer platforms, by implementing an intranet system, the Web-based technologies which provide a common user interface such as Netscape WWW browser across disparate platforms, enable the development of cross-platform applications, and the integration of existing legacy applications and databases. It is another cost-effective way of achieving enterprise-wide integration of its computer systems, and therefore, avoids spending hard cash on replacements of the existing hardware and software systems.

Intranet also has drawbacks. One major concern is the design and maintenance of those Web pages. With the standardisation on Web technology, design of the Web pages presented to users, is critical for effective communication and information flow. Bad design will affect users viewing effectiveness, especially when many pages are linked up with no proper control. To maintain the Web pages, solely relying on technical support staff is not sufficient, as normally these pages will be required to be updated regularly that these requests may not be fulfilled from time to time by them alone. Thus, end user involvement is crucial for the success of such an approach. Very often, end users will be the persons who update the contents of those pages. As a result, sufficient training has to be provided to new comers. Another major concern is the security issue, especially when an intranet system can be accessed externally. Proper procedures and associated control programs have to be set up to control the security of the internal and external access, which allow a Web page to be read only when proper authorisation is produced and recognised. For external access, firewall has to be installed to protect the internal system from unauthorised access.

3. Current Situation

The number of intranets installed is growing fast. This phenomenon coincides with the exponential growth of Internet in the last ten years. By 1995, International Data Corporation (IDC), estimates that there were 100,000 intranet web servers in the U.S. alone, and this number will grow to 4.7 million by the year 2000 [Hills 1997]. Business Research Group estimated that 70% of all U.S. corporations have intranet in 1997, up from 55% in 1996 [Koprowski 1997]. These companies as diverse as Hallmark Cards Inc., IBM Corp., Wells Fargo & Co. Inc., and Rockwell etc., are deploying intranets for tasks ranging from faster treasury-management services to more efficient manufacturing operations. Organisations are adopting intranet-based applications at an explosive rate as cost-effective ways to improve corporate communication and automate business processes [Sommers 1997].

According to [Koprowski 1997], collaborations within and between marketing, research, engineering and other departments; database access; customer service; order management; and inventory management were the most popular intranet application, since intranets can support rapid, flexible, and wide information flows up, down, and across large enterprises. Kennedy [1997] also points out, an intranet can surmount technical as well as organisational obstacles to information flow, whose applications include: corporate communications, sales

support and fulfilment, employee information, database linkages, global financial trading, and supporting on-site consulting.

In Hong Kong, intranet presence is still insignificant, as compared with other places such as the U.S. According to a preliminary survey conducted in 1997 [Lo, Tam 1997], few of the local companies were using intranet, except some computer companies who themselves are intranet services providers. There were no exact figures about the actual number of intranet systems or servers installed in Hong Kong at that time. However, in the coming years, it is likely to see more and more intranet systems emerge, and it is possible that more companies will be joined together through intranet links across Hong Kong and China to conduct their businesses in the near future.

4. Research Method

The main objectives of this research are to find out the current status of intranet use in Hong Kong, to investigate the difficulties encountered during the implementation process in terms of technical support, end user training, and security, and then to verify whether their initial expectations are met by deploying intranets. To achieve these objectives, surveys were conducted, which were addressed to two major parties, i.e. intranet providers and local companies. A total 150 questionnaires were mailed or e-mailed to 100 organisations. These companies were selected from Hong Kong Electronics Handbook Directory - The American Chamber of Commerce in Hong Kong.

Currently, there are about 7 major intranet providers in Hong Kong, who provides full intranet solutions including design, installation, technical support, and staff training, to local companies. All of these providers are computer or telecommunication companies, namely, Hong Kong Telecommunication Ltd., Novell Hong Kong Ltd., Automated Systems Limited, IBM (HK) Ltd., and Linkage Online Ltd., Unilinx International Ltd. and Powernet Internet Group. These companies vary in size and expertise, but they more or less provide the same kind of services. In fact they are the major driving forces behind the intranet penetration into Hong Kong market.

Majority of Hong Kong companies belong to small and medium size categories, which has less than 500 employees. The problems usually encountered by them in terms of technology advances, are mainly associated with lack of technical expertise and financial resources. Thus, they tend to be less reluctant to invest in new technologies. For large organisations such as Hong Kong Government and public utilities companies such as Hong Kong Gas Ltd. and China Lights and Power Co., though financially they are less concerned, the potential changes or impact of implementing a completely new concept, will usually deter them from using intranet. These concerns may be why in the last few years, we saw few intranet applications in local companies.

Through this survey, questions were asked to find out whether these companies have the existing facilities or expertise to meet the basic requirement of implementing intranet. For those companies which already have intranet in place, we want to investigate how well the intranets were used and the problems they encountered. These questions were divided into 3 sections. The first section addresses the selection and use of hardware, software, the second section addresses the workflow or business process management and engineering, and the third section addresses technical support and staff training.

5. Results

Up to the time of this report writing, we received around 44 responses representing a 29% response rate. The response rate is considered quite acceptable. Within this paper, we conducted some analysis based on these results. The profile of the respondents is shown in [Table 1], with majority (84%) from the service industry. Many of them are still at the stage of evaluation of possible intranet deployment. Others who already deployed intranet, only migrated to intranet platform in the last one or two years. In the following sections, we present our investigation in three sections, i.e. technical complexity, operational feasibility, and maintenance and staff training.

Industry	Number of respondents	Percent
Finance, insurance, and real estate	1	2%
Transportation, communications, and public services such as gas and electric	12	27%
Retail Trade	25	57%
Manufacturing	6	14%
	44	100%

Table 1: Respondents by Industry

5.1 Technical Complexity

All of the companies we surveyed have more or less applied computer technology to conduct company businesses. As shown in [Table 2], 57% of them already have local area networks (LAN) in place, and quite a few (11%) have set up wide area networks (WAN). A noticeable 18% of them have taken intranet approach. Among these companies, most of them (75%) have their own expertise to design, install, and maintain their computer systems, while we also find a few (25%) outsource these tasks to computer companies rather than maintaining their own computer teams. However, all of the intranet users have their own computer expertise. These is no strong indication of a relationship between computer use and nature of company business.

Existing Systems	Number of Companies	Percent
Wide Area Network	5	11%
Local Area Network (only)	25	57%
Intranet Approach	8	18%
None	6	14%
	44	100%

Table 2: Respondents by network uses

Regarding the technical complexity, most of the companies said that they can understand the intranet concepts, and believe that themselves would have the capability to handle the technical issues with certain level of assistance from service providers. Some (6%) indicated that they never heard about intranet before, or think that intranet is too technical (13%), or have no practical use to them (15%). 29% of the respondents concern that intranet may cause too much impact or changes to them, while 20% and the remaining 17% of the respondents regard Web page maintenance and data security respectively as their main concerns, see [Table 3].

	Number of Respondents	Percent
Never heard of	5	6%
Too technical	12	13%
Have no practical use	13	15%
Not sure of impact	26	29%
Security	18	20%
Maintenance problem	15	17%
	89	100%

Table 3: Why do not use intranet?

5.2 Operational Feasibility

Intranet approach support business operations on the Web. To comply with this approach, it means that a company has to make certain changes. Therefore, it imposes potential impact on the traditional approach which relies on either manual processes or other networking systems. Whether intranet approach will help them to conduct their business processes more effectively and efficiently, is a question which they need to find out. According to our survey, these companies are involved in a wide range of businesses, see [Table 1]. The service that they use the most is e-mail. Some of the companies (29%) do put company's information on Web servers for employees to look at. A few (9%) of the companies allow limited external access of their internal systems, mainly for marketing purposes. [Table 4] shows the overall picture of the main uses of intranet.

	Number of Companies	Percent
E-mail	8	38%
Web page surfing (internal only)	6	29%
Web page surfing (with external access)	2	9%
Ftp, telnet	5	24%
	21	100%

Table 4: Main intranet uses

As indicated in [Table 4], the most popular use of intranet is the e-mail. With e-mail, company employees have more option to communicate effectively beside the traditional telephone and fax. However, it is still regarded as an informal way of communication. Paper documentation has to be produced in many critical business processes. Regarding the Web uses, usually only a handful of information is put on the Web, mainly associated with company's background and services offered, which are seldom required to be updated. This situation reflects that these companies are still hesitating in driving intranet into its full use. As indicated in our survey, the main concern of these companies is that they do have sufficient expertise to develop dynamic Web pages with proper control, and existing staff are not able to update the contents of the pages themselves, which are the issues addressed below. In addition, people are still concerned about internal and external security problems, especially for some sensitive information.

When asked whether they have met the initial expectation of deploying intranet, all of them showed their confidence in intranet, though exact results could not be seen in the mean time in such a short period of time. Overall, it seems that though intranets are used, they are limited to certain functions of the company processes, and haven't been introduced into a wider spectrum of company operations, in particular regarding the Web use. In other words, these companies haven't enjoy the real benefits which intranet provides.

5.3 Maintenance and Staff Training

Intranets provide an alternative approach for business operations. One major breakthrough is to standardise information such as sales order, on Web basis. These pages may require to be updated regularly or to be extended to include additional information. The question should be asked would be who should maintain them, the computer staff or the end users. If it is the responsibility of computer staff, could they fulfil the requests of all the end users? Or would this have any risk of leakage of confidential data. If it is the responsibility of end users, then whether they have the knowledge or skills to handle such tasks, is a major concern.

According to the data obtained so far, few companies have reached the stage to conduct businesses on the Web themselves or with their business partners, because they are afraid that it will bring too many changes to the existing systems, and also require more end user computing or end user involvement, and therefore may

cause more errors if applied wrongly or prematurely. From this standpoint, it is not hard to see that it may take years before intranet become widely used in the business community, though many successful examples can be found elsewhere.

Right now, according to our survey, it is the computer staff who carry out the duties of developing and updating the web pages. For those companies, who outsourcing these tasks to computer firms, the internal staff are rarely involved in the actual development. At current stage of intranet application in Hong Kong, this level of arrangement is acceptable. However, for wider range of intranet applications in a company, proper procedures have to be set up to regulate the maintenance of the information on the Web, and staff training programme. To successfully conduct business on the Web, end users knowledge and involvement is a must. This will imply additional financial burden a company has to take as against the benefit that intranet application will bring.

6. Conclusions

In the paper, we have discussed various aspects of commercial intranet applications in Hong Kong in three sections, i.e. technical complexity, operational feasibility, and maintenance and staff training. These discussions are based on a preliminary survey that we are currently conducting. This research was originated from the widespread popularity world-wide of internet and intranet in recent years, and the confusions and requests from Hong Kong local business communities. Therefore, we hope the outcome of this research will serve as a general guideline for business communities to conduct their own evaluations.

The overall picture of intranet applications in Hong Kong is not very optimistic. According to our survey, only a limited number of companies using intranet to conduct their businesses. The reasons vary from company to company. However, the initial results indicated two major concerns. One of the major concerns is the unknown possible impact of deploying intranet to a company's staff and operations, and the other is the maintenance problem of the Web pages in an intranet systems. There are also other concerns such as security and staff training, which have to be resolved. In fact, many local company in Hong Kong have meet the basis conditions of deploying intranet in terms of hardware, software, and technical support from service providers. It is a matter of time to see intranet become a real business opportunities in Hong Kong.

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Using Collaboration in Support of Distance Learning

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Abstract: Trends in pedagogy and in technology are converging to make distance learning environments of the twenty-first century meet the needs of the learner of the 21st century. Trends in pedagogy have encouraged the movement away from the learner as a passive recipient of information and toward a more active model of learning. Earlier generations of distance learning media and methods were ill-suited to the active learning model. More recent technologies of distance learning, most notably computers, the Internet, and interactive video, have the potential to support the new model of learning. This paper describes different strategies to integrate activities to support this new model of learning into courses in two distance learning programs. An integral component of higher education in the new millennium will be collaborative learning, not only because it supports active learning, but also, because it is required for the workplace for which we prepare our students. Moreover, as more corporations become global, collaboration will be mediated by technology. The paper also discusses ongoing research being conducting to measure the effectiveness of technology-mediated collaborative learning.

Collaboration will be the hub in the wheel of pedagogical strategies necessary for success in the new millennium. The 21st century will see a great expansion in the use of distance learning in the education environment. The teacher-student relationship is increasingly mediated by the use of technology. No where is this more evident that in distance learning. The typical distance learner is a mature person with a substantial number of commitments in addition to furthering his/her education. This paper investigates the implications of the reliance upon technology by distance learning programs. It addresses such questions as, what pedagogical shifts teachers should make to achieve effective learning outcomes and what changes institutions need to make to support the distance learner in order for this type of program to succeed. The authors report on findings derived from their joint research, from current literature, and from the practice of teaching in and supporting distance learning programs at their institutions.

The initial driving force behind distance learning programs was the desire to provide opportunities for learning to individuals who are not able to attend an educational institution, to increase the number of educational experiences available to individuals, and to provide educational opportunities to individuals at times and places of their convenience. This third reason for distance learning programs has taken on increased importance in proportion to the number of working adults seeking higher education. The early modes and media of distance education met these needs by providing educational opportunities for students who did not reside nor commute to campus. [Edelson 97]. These modes and media included correspondence courses, courses on audio and video tapes, and courses broadcast via satellite and cable television. Distance learning programs employing these media can successfully deliver the educational programs based on the lecture-text-exam model of education to the distant student. According to this model of education, the two primary activities that produce successful learning are attending lectures delivered by content experts and reading texts written by content experts. Evaluation is accomplished by examination. In this model the learner is the passive recipient of information absorbed through listening, seeing, and reading.

Shifts in learning theory, especially in adult learning theory, challenge the lecture-text-exam model of learning [Knowles 84]. They indicate that learning is achieved when the learner is actively engaged in the creation

of knowledge rather than the passive recipient of information [Bruner 73, Brooks & Brooks 93]. According to many learning theorists this creation of knowledge is social and it arises out of conflicts between the learner's prior knowledge and new observations [Brooks & Brooks 93]. In this model, learning is achieved within an environment that fosters interactions between learners and instructors, between learners and other content experts, of learners with a rich set of content resources, and among the learners themselves. This learning environment should support the learner's active questioning of instructors and content experts as much as receiving information from them. It should support the learner's active exploration and manipulation of content materials as well as reading texts. The environment should support collaboration among learners and opportunities for peer review of learners' work [Ben-Jacob & Levin 98a]. This active learning model contrasts sharply with the passive, lecture-text-exam model. The active model is learner-centered, the learner's questions drive the creation of knowledge. The passive model is teacher-centered, the teacher's knowledge is what must be transmitted to the learner. The shift from the passive to the active model of learning is accompanied by a shift in emphasis from evaluation of what the student has learned toward assessment of student learning. Evaluation is a summative exercise concerned with whether the student has absorbed and integrated the teacher's knowledge. Assessment is ongoing and integrated into the learning experience.

The shift from the passive to the active model of learning requires a concomitant shift in the roles of learners and instructors [Barr & Taggart 95]. Learners need to assume a far greater responsibility for their learning. Besides choosing what and when to learn, they must become active questioners and investigators. The role of the instructor shifts from disseminator of information to facilitator of learning.

The earlier media of distance learning are not well suited to the active model of learning and its new roles for learners and instructors. However, recent developments in instructional technology have led to new trends in distance learning that are better suited to the active model of learning, provided their use is accompanied by appropriate shifts in teaching strategies. Technology, academic research and pedagogical innovation on one side, balanced with the increase in the maturity level, chronological age and personal commitments of the college or university student of today on the other side have encouraged the popularity of a redesign of the structure of the learning environment for higher education. Demographics, geography, and the desire to further one's education has, along with the aforementioned factors, made distance learning networks or asynchronous learning networks blossom into a viable mode of learning [Ben-Jacob & Tucciarone 97]. It is, however, true that distance learning networks mean different things to different institutions. The fundamental medium can be videotapes, videoconferences, audio-conferences, online tools, or any combination.

In the remainder of this paper we (1) describe the institutional contexts of distance learning programs in which we teach; (2) briefly describe the design of courses we teach within these programs, including a discussion the pedagogical shifts necessary to the achievement of successful learning outcomes in distance learning environments; and (3) report on the authors' research to measure the effectiveness of technology mediated collaborative learning activities of our distance learners.

The Institutional Contexts

Mercy College is a comprehensive college in the New York metropolitan area offering undergraduate and graduate degrees. The college is an independent, four-year institution that serves some 7,000 students, both traditional and non-traditional, on several campuses and learning centers. The students vary in age, race, cultural heritage, and native language. Approximately 27% of the students are of Hispanic descent, while 21% are African-American, and 3.5% are Asian/Pacific Islander. Students come from 79 countries and speak more than 30 native languages. It is a college that is committed to the advancement of technology in education as can be evidenced by activities that deal with the infusion of technology throughout the curriculum.

In particular, Mercy College supports MerLIN, an online educational system which offers a range of online courses from sundry disciplines ranging from mathematics and the sciences, to psychology, business and the humanities. Quite recently, the College has had three online bachelors degree programs approved - computer science, business, and psychology.

MerLIN, Mercy College Long-distance Instructional Network has its courses' underlying framework as forums. For each forum, the professor can post public messages arranged in threads of conversation that include discussion of topics, homework assignments, answers to questions posed, etc. Private discussion between lecturer and student or students can take place via e-mail. Additional features of the system include teleconferencing for live

typing sessions, including online office hours between professor and students, and file libraries, which are documents for users to read online or copy to their computers.

DePaul University is the second largest Catholic university in the United States, enrolling 17,800 students in 130 undergraduate and graduate programs. Like Mercy College, DePaul is an urban university with five campuses in the Chicago metropolitan area. DePaul prides itself on serving a diverse student body; having been cited by *Time* and *The Princeton Review* as one of the top seven school in "The Best College for You" for its success in recruiting a diverse student body. Ten percent of its student body is African-American; 9% is Hispanic; and 8% is Asian-Pacific. Over half of DePaul's student body is non-traditional in that they are over 25 and/or work full-time while attending university. DePaul University has a history of developing innovative programs in higher education and attempts to continue this tradition of innovation in its use of technology in teaching and learning, especially its distance learning programs.

Many of DePaul's academic programs are committed to fully integrating the use of technology into the students' learning experiences. Computers and the Internet are used extensively to provide students with online academic resources; the ability to communicate with instructors, peers, and "visiting" content experts through the use of e-mail, listservs, electronic discussion groups, and chat rooms; and a full set of online student support services. Among its distance learning initiatives DePaul makes use of interactive video through a network of interactive video rooms on four of its campuses. Many of DePaul's interactive video courses make extensive use of computers and the Internet to supplement the classroom experience with content web pages and links, e-mail, online discussion groups, chat rooms, and multimedia materials and applications, as well as customized tools developed in house to support online learning.

Making the Pedagogical Shift

The new technologies for distance learning described here, interactive video, computers and the Internet, have the potential to provide a learning environment that can support active learning, but only if they are married to important shifts in teaching styles, content delivery, and learning activities. Without these changes interactive video courses simply allow instructors to lecture to multiple sites simultaneously and Internet courses are just correspondence courses by e-mail.

At Mercy College, Ben-Jacob teaches Discrete Mathematics using the MerLIN system. E-mail is used for individual communication between students and the instructor. Discussions of how to solve problems, problem sets, partial solutions, and final solutions are posted in forums. For some problem sets, students are encouraged to post partial solutions to the forum for comment and review by their peers. This results in students learning multiple approaches to solving problems and in learning by teaching. Each major topic is introduced with a question that can be answered by the students without specific prior knowledge of the subject matter. Ben-Jacob has taught this particular course before both online and in the traditional classroom setting. In the past, in the traditional classroom, she has always been able to cajole the reluctant student to express at least an opinion with regard to the classwork; online, however, if a student is reluctant to post an opinion and chooses not to respond to the forum posting, it has proven difficult to get him/her to participate. Most of the students in this situation have admitted their reluctance stems from the fact they are not sure their responses would be correct. To overcome this, the initial common sense or "thought" question is posed. As a prime example, prior to introducing the subject of logic, the students are asked to discuss the differences and similarities between three very short logical arguments. Two of the arguments are logically equivalent but do not use any of the same words in their propositions. The third argument, which is different logically from both of the others, uses the same words that appear in one of the former arguments. The students are advised they do not need to read the text to respond; they are to use their intuition, and that we are looking for their opinions, not "right" or "wrong" answers. Another pedagogical tactic employed in the online course is that of posting a request for peer help with a problem before Ben-Jacob solves it. Discussion questions are well suited to a distance learning course. Ben-Jacob has found that the more technical the online course is, the more reluctance there has been on the parts of the students to engage in online exchanges, and the greater the need for her to facilitate the beginning of the discussions.

At DePaul University, Levin teaches Ethical and Social Issues in Computing. This course is taught at two of DePaul's campuses using interactive video and makes extensive use of the Internet. In order to make the classroom discussions interactive each class period has at least one planned student delivered program from each of the two class sites. This may be a summary of an article, a presentation of individual or group work, or a debate of

an ethical issue with the proponents at different sites. The course has a web site that contains links to many content resources that have been identified and annotated by students as well as the instructor. The course uses HyperNews, an asynchronous computer conferencing system, for required online discussions. We have two types of discussions: topics discussions and discussions of readings. Over the course of a quarter each student is required to summarize one reading assignment in the readings discussion group. Students are encouraged to post "I don't understand why the author says this" messages in this discussion. While students, especially the summarizer, are encouraged (awarded extra credit points) for posting good answers to these questions, the instructor usually answers these questions. Nevertheless, by using this time and space for initial discussion of the readings, students come to class well prepared.

The instructor posts opening questions in the topic discussions. These questions typically encourage students to take a position on an issue. In the course of the quarter each student is required to post a minimum of five initial responses to a topic question and respond to at least one topic thread (discussion initiated from an initial response) each week. A new topic discussion is started each week and lasts two weeks. After the first two weeks, the instructor does not directly participate in the topic discussion beyond posting the initial question. Instead suggestions, feedback, encouragement, and assessment are provided to authors directly by e-mail. This allows the students to take full ownership of the discussion. With a few minor exceptions students contribute far more than the minimum to these discussions.

In order to provide meaningful experiences in distance learning environments we believe instructors should act as models and facilitators. The distance learning environments, whether the Internet or interactive video, may not be a forums in which the student feels comfortable conducting an intellectual conversation or doing work. It is important that show the students how to do this. However, it is equally important that the instructor knows when, after modeling the behavior, to "step aside," allow the students to take ownership of the conversation, and assume the role of facilitator. We would like to model each course beginning with the professor acting as the hub of a wheel composed of students as the spokes. As the course progresses, the professor should remove him/herself from the center of the wheel and serve in a consultative or facilitator capacity to stimulate dialogue and to pose questions (Ben-Jacob & Tucciarone, 1997).

In general, of course, students need a clear understanding of what is expected of them and the objectives and outcomes of each activity. These needs are heightened in the distance learning context where nonverbal means of communicating uncertainty or discomfort are not possible.

Current Research: Using the Internet to Support Collaborative Learning

Learning activities that encourage collaboration are particularly important for students of the twenty-first century. The student of the twenty-first century will be a lifelong learner. The sharp delineator between school and work will fade. In the work environment collaboration with one's fellow workers is essential for success. We believe that it is equally essential that we provide our students with meaningful collaborative learning experiences. Moreover, the concept of the corporation of the 21st century will be encompass virtual corporations a professional colleague will as likely be across the country or across the ocean as across the hall. If we are going to prepare our students for the working conditions of the 21st century we should begin by preparing them to work collaboratively in an online environment.

Collaborative learning is one of the activities we believe can be supported in the online learning environment. There is evidence that collaborative learning in an online setting can be as effective as in a face-to-face setting [Hiltz & Benbunan-Fich 97, Ben-Jacob & Levin 98a]. Our research includes a study of the effectiveness of student collaboration in online environments.

Ben-Jacob has taught Discrete Structures both online and in the traditional classroom setting and in the Spring semester of 1998 taught both the traditional and Internet sections concurrently. This allowed for a closer comparison of the two learning environments. The same material was covered and the same types of examinations and projects were assigned to both classes. This particular course at Mercy College is a junior level achievement course. As such, it is used to evaluate the students in the competencies of written communication, logical thinking and quantitative reasoning. To date, this has been done via a semester project that each student completes individually. In Spring 1998, however, Ben-Jacob assigned two such projects to students in both sections. One was done individually and the second project collaboratively. For the team project, students in the traditional section met face-to-face, while students in the Internet section used e-mail for their collaboration. Students were asked to

describe and critique their own and their partners approaches to problems; they were evaluated with regard to all the competencies.

In the Winter 1998 Quarter at DePaul University, students in Levin's Ethical and Social Issues in Computing worked collaboratively in groups of three on projects. Half of the teams met face-to-face to work ; while the other half used e-mail, HyperNews, and the DePaul Annotator, a web-based tool to support annotation of text, graphics, audio, and video. The final product took the form of a traditional text document, a hypertext document, or videotape.

Our evaluation of the comparative effectiveness of face-to-face and online collaboration is based upon a student survey and our assessment of the products of these collaborations. A copy of the student survey is attached as an appendix to this paper. The results of the study showed that at DePaul students had some added difficulty managing collaboration without face-to-face meetings, but the quality of work was no for those working at a distance was as good as for those who met face-to-face. At Mercy College the quality of work produced by the collaborative team working at a distance was significantly better than for those in the traditional class.

Future research plans include a distance learning course jointly offered by both Mercy College and DePaul University. Learning groups will be formed in such a way as to include a mix of students from both institutions. Of course, surveys to measure student opinions and levels of satisfaction will be administered.

Based on their preliminary results we contend that central to the educational model of the 21st is the concept of a Collaborative Learning Network (CLN). Elsewhere we have described the CLN as a learner-centered human network designed to facilitate interaction and collaboration among learners as well as between learner, instructors and other learning professional [Ben-Jacob and Levin 98b].

The new millennium brings with it an innovative model of learning into the environment of higher education. The roles of the teacher and the learner will be changing and the need to incorporate collaborative learning into this model is fundamental in order to insure educational success.

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Appendix
Student Survey on Distance Education and Collaborative Learning

'Please answer the following on a scale of 1 to 5.

1- strongly disagree 2 - disagree 3 - no opinion 4 - agree 5 - strongly agree

Part I - Distance Education

1. Distance learning is a viable means of furthering one's education.

1 2 3 4 5

2. Student work in an online course should be assessed the same as students taking the course in a traditional classroom setting.

1 2 3 4 5

3. Students have to alter their learning styles when taking an online course.

1 2 3 4 5

4. Instructors have to alter their pedagogical styles when teaching an online course.

1 2 3 4 5

5. Assignments in an online course should be harder than the assignments in the same course taught in the classroom.

1 2 3 4 5

6. Exams in an online course should be easier than the exams given in the same course taught in the classroom.

1 2 3 4 5

7. Projects in an online course should be more complex than the projects assigned in the same course taught in the classroom.

1 2 3 4 5

8. The integrity of the academics in an online class is lower than that of a class taught in a traditional setting.

1 2 3 4 5

9. If I had to take a course and had my choice of environments, I would take it as a distance learning course.

1 2 3 4 5

10.It is easier to learn the material presented in a course in a traditional classroom setting than in an online environment.

1 2 3 4 5

11. Distance learning programs will grow in popularity in the future.

1 2 3 4 5

12. It is better to use technology to enhance a traditional classroom environment than to deliver an entire course in a distance mode.

1 2 3 4 5

13. The Internet is an effective medium for distance education.

1 2 3 4 5

14. Interactive video is an effective medium for distance education.

1 2 3 4 5

15. Broadcast video is an effective medium for distance education.

1 2 3 4 5

16. Videotape is an effective medium for distance education.

1 2 3 4 5

17. CD-ROM is an effective medium for distance education.

1 2 3 4 5

18. Telephone and voice mail form an effective medium for distance education.

1 2 3 4 5

19. Written correspondence is an effective medium for distance education.

1 2 3 4 5

18. A combination of media should be used in any distance learning course.

1 2 3 4 5

Additional Comments:

Part II - Collaborative Learning

1. When working collaboratively, I am able to communicate effectively with other members of my group.

1 2 3 4 5

2. Our group was able to work effectively as a team.

1 2 3 4 5

3. I learned from the other members of my team.

1 2 3 4 5

4. My team members learned from me.

1 2 3 4 5

5. I contributed more than the other members of my group.

1 2 3 4 5

6. I am comfortable having my responses(s) determined by a collaborative effort.

1 2 3 4 5

7. The appropriate amount of time was taken for group management.

1 2 3 4 5

8. I learned more doing this project collaboratively than I would have working individually.

1 2 3 4 5

9. It is easier to work alone than as part of a group.

1 2 3 4 5

10. When working collaboratively, everyone in the group should receive the same grade.

1 2 3 4 5

11. Every team member should evaluate the percentage of work input by the other members to aid in the evaluation process.

1 2 3 4 5

12. Every team member should evaluate the quality of work input by the other members to aid in the evaluation process.

1 2 3 4 5

13. I consider myself a proponent of collaborative learning.

1 2 3 4 5

14. Collaborative learning works better in the traditional classroom environment than in the distance education environment.

1 2 3 4 5

15. The ideal number of persons per team for collaborative projects is:

2 3 4 5 6 greater than 6

Additional Comments:

Designing Web Courses for Different Learning Styles

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Abstract: The way courses are designed and synthesized greatly affects how learners understand and learn. "Educators have long been aware that conceptual and perceptual styles, past experiences, and cultural background affect the way learners learn"(El-Tigi, Lewis, Mac Entee, 1997). Good teachers consider individual differences and learning styles as they teach. Now, increased use of the World Wide Web as a teaching tool makes it imperative to create courses that are for the different learners. The purpose of this paper is to give teachers some guidelines in creating courses that will attract all different types of learners.

1. Introduction

Traditionally, education started in the classroom. Ever since the concept of teaching/learning began, prime stress was given to the words of the teacher, thereby placing much of the onus of teaching on the teacher. The methods and materials used for teaching are geared to specify much more transition needed between these two topics. However, in recent years, there has been a paradigm shift from behaviorism to constructivism. As this shift occurs, the traditional classroom learning environment is being changed to distance education allowing the students to learn in a real-life context, experience collaborative learning and negotiate multiple perspectives on an authentic problem source.

As the 21st century is approaching, more and more universities are teaching courses on the Internet. The traditional classroom is changing to the distant classroom. The introduction of the Internet allows virtually seemless interactions between people world wide. This avenue of communication is rapidly becoming the preferred long distance communication tool for distance education. Any course can be accessed via the Internet by a person anywhere in the world if the person has a computer, a modem and Internet connection.

As these courses arise, there must be some guidelines in the design and development of the courses. The key area that teachers must understand is that learners learn in different styles. Not one learner is alike. If teachers teach in a manor that is not suitable to their learners' style, than the learners' discomfort with the type of teaching could interfere with the learning process. Therefore, the teachers should not develop one single teaching style but several to adapt to the different learners for their courses.

2. Designing for different learning styles

Today's classroom is not homogeneous classroom, it is made up of learners from diverse populations with different learning styles. There are four basic types of learning styles:

- active and reflective learning: learners who learn by being active and learners who learn by reflecting on information given to them;
- sensing and intuitive learning: learners who learn by solving problems and learners who learn by discovering new ways to solve problems;
- visual and verbal learning: learners who learn by seeing and learners who learn by hearing information; and

- sequential and global learning: learners who learn in a certain order and learners who like to jump from one lesson to another in different order.

In designing courses, the teacher must create the course for learners from diverse populations and who have different learning styles. Therefore, following are suggestive guidelines on how to create a course that suits of four different learning styles. The course must have a variety of activities for all four learning styles.

Active and reflective learning: Group interaction and discussions: Create group interactions where students can work as teams and teams create topics to be discussed in a class discussion group. Create a location for students to upload their projects. At this location, allow students to comment on other students work.

Sensing and intuitive learning: Illustrate problems in a real world situations. Relate information to students fields. If you are teaching statistics to business students and the area being covered is one way ANOVA, use an inventory problem to illustrate your point.

Visual and verbal learning: Use graphics, pictures, charts, diagrams, film clips and audio clips to relate the information given to the students. Make sure that the visuals used have a relation to the information that is being given. Do not use visuals just to have something pretty on the screen.

Sequential and global learning: Create the information maps for the students. These maps can be used for the sequential learner who wishes to go in order or for the global learner who wants to jump from subject to subject. Make sure the information maps are clearly defined.

3. Summary

Learning at a distance should be no difference than learning face to face for the learner. The learning happens the same way. The learner gains information and processes it. The only difference is the medium which the information is given. Therefore, in the designing of the course, the teacher will be using the same information but modifying the presentation of the information to fit the medium.

"Educators have long been aware that conceptual and perceptual styles, past experiences, and cultural background affect the way learners learn"(El-Tigi, Lewis, Mac Entee, 1997). Good teachers consider individual differences and learning styles as they teach. Every level of the course should be designed for the learner with the learners age, learning styles, and culture in mind, in addition to several other characteristics.

Teachers need to keep in mind during the designing of the course is that each learner has different learning styles and that he/she must create a course to fit all of the different learning styles: active and reflective learning; sensing and intuitive learning; visual and verbal learning; and sequential and global learning. Besides designing for the different learning styles, teachers need to be aware of the layout of the course. The layout is very important. It is what attracts the students. If the layout is student friendly, the student will be at ease with the learning process. If the layout of the course is cluttered or disorganized, the student will become distracted and disenchanted with the course. Therefore, it is important not only for the content of the course to be designed for different learning styles but also the layout of the course.

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When Java Applet Meets Object Database

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Abstract: Internet database connectivity receives more and more attention when the Web is getting complex. Several technologies can be used to provide the database connectivity for the Web, including SSI, CGI and mobile objects. Java, the representative of the mobile objects, is successful in its seamless connection with the Web technology. Connecting databases with Java smoothly brings database connectivity for the Web. This paper is intended to argue the relationships among the Web, Java applets, and the object databases. We promotes our design and implementations of Java language binding for an ODMG-compliant object database, the WOO-DB. A WOO-DB gateway is introduced on the Web server host to relay messages between Java applets and the WOO-DB. Issues and potential uses of the WOO-DB Java system are given in the paper.

1. Web Application Evolution

The WWW provides a new infrastructure for distributed computing. Distributed applications can easily deploy uniform user interface on different platforms. It is no wonder that applications on the Web grow rapidly. The DBMS plays an important role in data management. Integrating DBMS's with the Web falls into two categories [Atwood 96]: (1) *Using DBMS's as page servers*: Web pages are stored in DBMS's instead of file systems provided by operating systems. It greatly helps the Web server management. (2) *Using DBMS's as application servers*: DBMS's act as data substract for applications running on the Web. This paper focuses on the second categories.

The evolution of Web applications carries in two dimensions, the *application paradigm* and the *data management*. Historically, there are two paradigms to generate Web pages on the fly, the Common Gateway Interface (CGI) and the Server Side Include (SSI). These two paradigms rely on the HTTP connection between the Web browser and the Web server. As the demand of more dynamic pages grows, the mobile object paradigm comes of age. Instead of using the HTTP connection, mobile objects may carry data by themselves or acquire data from application servers. Figure 1 depicts these three paradigms.

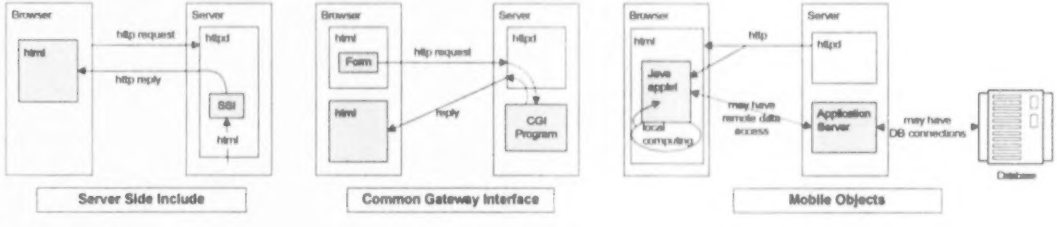

Figure 1: Web Application Paradigms.

Applications on the Web usually manage data. Earlier applications contain less data. Saving data on the file system is adequate. As the amount of data grows, using DBMS's to manage the data is a reasonable way. On the other hand, many traditional database applications tend to migrate to the Web. They do manage large amount of data. Modern Web applications suffer complex data and variety of demands. It is believed that the ODBMS manages data against new application demands that traditional RDBMS can not satisfy with.

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2. Trends

Technologies evolve by generations. As for the Web, databases and mobile objects are two main foregoing directions. Relational databases had led the data management for years. As the new application demands arising, the relational database only is not enough. The object database technology is rising. It satisfies broad application demands and is capable of managing versions, security, and evolution of data.

Mobile objects travel around the world. They are downloaded from Web servers and executed on Web browsers. By deploying the client-server paradigm, mobile objects construct various kinds of Web applications. Java applet is the de facto mobile object standard because of its widespread virtual machine. Nearly all Web browsers provide the Java virtual machine to execute Java applets. Java provides two communication primitives, Java socket and Java RMI [Sun 97b]. Java socket follows the BSD socket convention. Applications using Java socket to communicate with each other must follow the same protocol. Java RMI follows the RPC convention. It uses method invocations as the communication protocol. Higher abstraction level makes Java RMI easier to be used and understood.

Beside the communication primitives, the persistence semantic of Java seems to be the most emergent feature that the Java users want. Ways of providing persistence capability for Java fall into several categories: (1) using relational databases as persistent stores, (2) modifications on Java language and its virtual machine, and (3) combining Java with object databases. Rothwell's Java Object Persistence [Rothwell 96], JOP, provides persistence capability for Java by taking advantages of Sun's JDBC [Sun 97a]. JOP provides persistence classes for Java programs to keep their data in relational databases. Atkinson leads a PJava project [Atkinson et al. 97] [Atkinson et al. 96a] [Atkinson et al. 96b] [Jordan 96] that aims to provide an orthogonally persistence system on Java with minimum modifications on Java language and its virtual machine. In the PJava project, several issues for designing persistent Java have to be examined, especially the transaction and some language semantics. Currently, Sun's PJama, comes with JDK 1.1.4 [Sunlab 97], has adopted the results from PJava to provide an experimental persistent programming system for Java.

In the prevision of the growing Java, Object Database Management Group, ODMG, created a special working group to define the object database standard for Java in February 1996. The standard had been finalized in May 1997 [ODMG 97]. Object Design, an OODB vendor, proposes a Java solution as the ObjectStore PSE/PSE Pro [ODI 97] [Udell 97]. ObjectStore PSE/PSE Pro provides a persistent storage engine, a set of class libraries, to help both Java application and Java applet to manage their data persistently. It uses the ObjectStore object database as the back-end storage system. Object Design does not claim that ObjectStore PSE/PSE Pro is ODMG-compliant implementation. On the other hand, POET Software proposes an object database with Java API, POET 5.0, and claims that it complies with ODMG Java solution [POET 97].

In terms of the foregoing directions of the Web, using Java applets with object databases would be a significant milestone of the Web application evolution. The remaining of this paper focuses on how to realize the ODMG Java binding system for Java applets.

3. ODMG Java Binding

ODMG defines the object database standards, including object model, object definition language, object manipulation language, and object query language. The ODMG Java binding specification [ODMG 97] defines the binding between the ODMG object model and the Java programming language as defined by Version 1.1 of the Java language specification [Arnold 96].

3.1 Overview

The fundamental principle of the ODMG Java binding is to make the Java object model and the database object model seem to be one. Programmers should perceive the binding as a single language system. The main goal of the binding is to provide Java with persistence capability. ODMG Java binding defines a type of classes concerning with persistence. These classes are called persistence-capable classes that can be understood by databases. Only instances of these classes can be made persistent. Besides persistence-capable classes, the binding also defines rules of mapping object models, Java ODL, APIs for Java object manipulation and query, and exceptions.

3.2 Mapping between Object Models

An object model contains syntax and semantics that describe an object system. Mapping two object models is to set a rule to translate syntax and regulate semantics. The Java ODL provides a unified type system. It maps types and constructs between the two models. For example, the ODMG *Object* type maps into the Java *Object* type. Java Object Manipulation Language, OML, defines how to create, delete, modify a database object, and how to access attributes and operations of a database object in Java. For example, one may use the *new* construct to create a Java object potentially corresponding to a database object.

There are some mandatory APIs defined in the binding. They are *collection* interfaces, *Transaction* interface, *Database* interface, and *Query* interface. Collection interfaces are provided to manipulate collection of objects. They have three special instances: *Set*, *Bag*, and *List*. The Transaction interface provides necessary operations for manipulating transactions in Java. It is important to note that all access, creation, and modification of persistent objects and their fields must be done within a transaction. The Database interface represents operations of a database. For example, applications should open and close a database by using the Database interface. The Query interface provides an entry for object query language. Applications may use the Object Query Language, OQL, to retrieve a set of related objects in the database. Note that the object instances of these four interfaces are not necessarily persistent.

3.3 Persistence and Transactions

Persistence and transactions are two important concepts in the ODMG Java binding. Generally, persistence behaviors can only happen within a transaction. Only when a transaction successfully completes, the changes on objects can be made persistent. The ODMG Java binding provides *persistence by reachability*. A transient Java object that is referenced by a persistent Java object will automatically become persistent when the transaction is committed. Instances of classes that are not persistence-capable classes are never persistent, even if they are referenced by a persistent object. There are two special cases that the referenced objects or attributes can not be persistent: the attributes modified with keyword *transient* and the static fields.

Transactions and threads play important roles in the ODMG Java binding persistence behaviors. The creation of a new transaction implicitly associates it with the caller's thread. There are three ways in which threads can be used with transactions: *Exactly-One-Thread-Exactly-One-Transaction*, *Multiple-Threads-Separate-Transactions*, and *Multiple-Threads-Shared-Transactions*. Currently, ODMG object model supports only the flat transaction model. Nested and long-lived transaction semantics are not included in the object model.

4. Applet-Capable Design

Based on the ODMG Java binding, we are intended to provide a Java binding subsystem for our OODB, the WOO-DB [III 97]. This paper suggests a flexible design and implementation suitable not only for the Java application but also for the Java applet. The big challenge of designing the system is to bridge the gap between the WOO-DB's object model described in C API and the Java's object model. Integrating the Java, especially the Java applets, with the OODB makes the Java become persistent-capable, brings Java connectivity for the OODB, and plugs OODB into the Web.

4.1 Design Issues

There are several issues about designing the OODB language binding systems. Semantics provided by the language binding system must be clearly identified so as not to be ambiguous. In the ODMG Java binding, the persistence semantic is defined by the transitive persistence model. Objects that are capable of being persistent are transient at the creation until they are assigned to be the database root objects or are referenced by other persistent objects. These assigned or referenced objects are made persistent when the transaction is committed.

Transactions are critical to such language binding systems. It defines the persistence manipulation boundaries for the system. In the ODMG Java binding, it supports only the flat transaction semantic. As the occurrence of multiple threads, transactions can be shared between threads but the concurrency semantics must

be handled by the program itself. The concurrency semantics provided by our system is designed in the following fashion: If the concurrency control problems occur within the process boundary, that is the situation of sharing transactions by multiple threads, our system guarantees the synchronization between objects by providing a thread-safe class library. If the concurrency control problems occur outside the process, our design decision is to do nothing within the process but to delegate the responsibility to the WOO-DB server.

Relationships play an important role in the object model. Unfortunately, ODMG Java binding does not define the Java relationship constructs. Therefore, no relationships can be *explicitly* declared by Java language. The only kind of relationship is the reference that *implicitly* happens when an object contains references of other objects. This is the only way that the persistence can be propagated in the ODMG Java binding.

As suggested in ODMG standard, there are three possible approaches to realize Java persistence capability. The post-processing technique is intended to process Java bytecodes and produces new bytecodes with persistence capability. If we build the Java binding system by using the post-processing technique, then our system needs to capture object definitions from bytecodes and register this information into the WOO-DB. The existing system libraries of WOO-DB may need to be rewritten. This costs too much. Make modifications on the Java virtual machine is not considered to be a good idea. This approach seems to be the choice of Java VM providers. Note that there is a serious drawback of the above approaches: the Java language semantics would be varied in different virtual machine. Therefore, we choose the pre-processing approach as the main theme of system design.

Java has good security features based on the Java virtual machine. One famous security constraint of Java applet is its restricted network connectivity. The Java applet can only connect to the machine in which its Web server resides. Suggesting a framework that can be used to support both the Java application and the Java applet would be a challenge. We apply the well-known three-tier model to construct the system. The middle layer can be presented as a library bound with Java applications or be recognized as an agent that bridges Java applets and the WOO-DB. The agent should reside in the same machine with the Web server. In fact, this strategy can support both the Java application and the Java applet with the same middle layer implementations. The key is to use Java RMI between the front end and the middle layer [Sun 97b].

Another issue for designing the system is how to provide the *single-level store* semantic. The basic idea is to wrap the WOO-DB by Java. The WOO-DB's system interface is presented as C API. The wrapping process is realized by introducing the *object management system* middle layer. The object management system wears the Java clothes outside and uses Java native calls to invoke the WOO-DB's C APIs inside. Applications will not know the persistence manipulation details. The tediousness for manipulating persistence is done by the object management system.

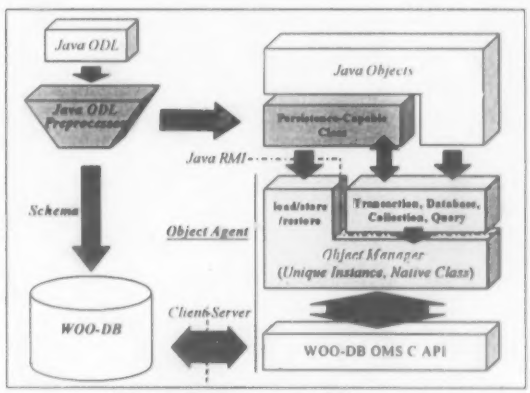

Figure 2. System Architecture.

4.2 System Architecture

Design of the system architecture comes from three main strategies: *pre-processing*, *three-tier modeling*, and *wrapping*. The main components of the architecture [Fig. 2] include (1) *Java Object Definition Language Preprocessor*. It reads Java ODL and registers the schema into database. In the mean time, it generates corresponding persistence-capable classes and inserts some necessary codes to help the Java OMS to make Java

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objects persistent. (2) *Object Agent*. It is the most important and complex component of our Java binding system. It represents the middle layer of the three-tier model and wraps the database for Java applets. Most important of all, it provides public interfaces for Java programs and private interfaces for persistence-capable classes to carry out necessary functions of Java binding. Object agent can be further divided into two parts. The Java binding API classes, *Transaction, Database, Collection, Query*, provide object manipulation API for Java applets; and the *Object Manager* provides the core interfaces that can only be used by system components through Java RMI. It acts as an object server running on the host in which the Web server resides. (3) *WOO-DB*. It is the back-end of the three-tier model. WOO-DB presents its object management API in C language. The *Object Manager* in the *Object Agent* communicates with the WOO-DB OMS through the native call of Java. WOO-DB provides the stable storage, global transaction management, and global concurrency control for the Java binding subsystem.

4.3 Object Agent

The Object Agent plays an important role in supporting Java applets database connectivity. Conceptually, it is responsible for transforming Java objects and database objects. The main function of Object Agent includes object persistence manipulations, transaction, database manipulations, query processing, and object collections. As for the persistence manipulation, the Object Agent contacts with the WOO-DB Object Management System directly through the Java native call. The mapping between Java objects and database objects is maintained in the Object Manager of the Object Agent. The persistence transparency is the main theme of the ODMG Java binding. Therefore, the Object Agent does not provide interfaces for application objects directly. Instead, it cooperates with the persistence-capable classes that are produced by the Java ODL pre-processor to hide the persistence tediousness. Other functions that may require object persistence are built upon the Object Manager part of Object Agent, including the transaction and database manipulation, query processing, and collection classes.

Transaction and database manipulations are the heart of the persistence Java execution flow. Figure 3 depicts the main flow within the Java OMS. The persistence-capable thread first opens a transaction by invoking the Transaction Manager, the Transaction class implementation in the Java binding, and then opens a database by invoking methods provided by the Database class. Upon receiving requests from the persistence-capable threads, Transaction Manager and the Database register essential information on the Object Agent. This information can be used to correctly mapping the Java objects and the database objects. The persistence-capable thread, then, performs the usual operations on some persistence-capable objects. These objects may communicate with the Object Agent through the persistence-capable classes to get or set their attributes, restore their contents, or make their updates on attributes persistent. Eventually, the persistence-capable thread may close the transaction by invoking the Transaction Manager. The Transaction Manager coordinates the completion of the transaction. The atomic commit protocol used by the Transaction Manager is the two-phase-commit protocol.

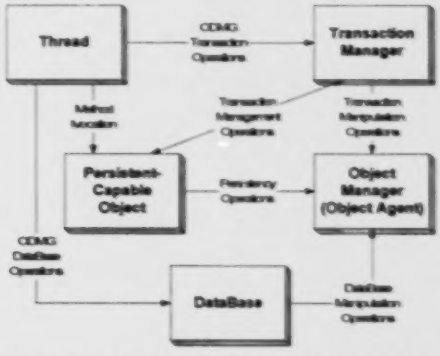

Figure 3. Main Flow of the Java Object Agent.

4.4 Programming

One objective of the system design is to provide a clear programming flow for users. Our Java binding

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system applies the common programming model used by RPC programming and CORBA programming. Programmers should first prepare a Java object definition and process the definition by the Java ODL pre-processor. The pre-processor generates essential programming classes and schema registration information for programmers. One should develop his Java applets by inheriting from the Java Abstract Class. Programmers can use standard ODMG Java API to help their programming on persistence systems. Eventually, the Java source will be compiled and bound with the WOO-DB OMS library. The desired Java bytecode is produced.

5. Concluding Remarks

ODMG Java binding connects the Java language with the object database systems. From the Java's point of view, binding with object databases provides the critical persistence semantics for Java. From the object databases' point of view, binding with Java gives them a chance to navigate the Web. In addition, the Java applet mobility provides excellent distribution of database applications.

Designing a Java binding system that supports both Java applications and Java applets is a big challenge. Instead of storing mobile Java byte codes in the originally existed object databases, we separate object states and execution codes. Our design is intended to preserve the heterogeneous connectivity of the object databases among different platforms and programming languages. Heterogeneity usually means different execution codes. Storing Java byte codes in the object database loses the heterogeneous connectivity. Therefore, no interoperability is possible. This is an important issue to be realized.

Currently, the WOO-DB provides ODMG C++ language bindings as well as the newly implemented ODMG Java language binding. Both language bindings are working on the Windows NT platform. The WOO-DB is capable of a standalone database or a client-server database. These features enrich the use of the WOO-DB, especially for the interoperability between different programming languages.

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Pathfinder: A Web Learning Environment for Elementary School Students at Taiwan

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Abstract: The goals of the project, Pathfinder, is to create a Web learning environment for children and conduct learning activities on it that could supplement the existing school curriculum. Pathfinder consists of four system components: (1) interactive online courseware, (2) virtual classroom, (3) instructional management, and (4) learning tools. Three levels of learning activities could be pursued in Pathfinder: (1) browsing and searching learning materials, (2) evaluating learning performance, and (3) conducting collaborative learning. The project is in the beginning of the second year currently.

1. Introduction

The government of Taiwan is investing its money in connecting k-12 schools to Internet. It is projected that most of the k-12 schools will have their own Web servers and join Internet society by the year of 2000. Consequently, the instructional reform that emphasizes on the integration of Internet and curriculum is one of the key efforts of government currently in implementing the NII project of Taiwan.

Pathfinder is a Web learning environment for elementary school students. The project is made possible with a three-year joint grant provided by both National Science Council and Ministry of Education of Taiwan. The goals of the Pathfinder is to create a Web learning environment with advanced information technologies for children and conduct learning activities on it that could supplement the existing school curriculum. The Pathfinder project is in the beginning of the second year.

2. System Components

System components of Pathfinder are created based on both literature reviews and personal empirical experience of the project director in the field of Web learning environment [Lin 98] [McGreal 98]. They could be categorized into four groups: (1) interactive online courseware, (2) virtual classroom, (3) instructional management, and (4) learning tools. The details of Pathfinder's components are shown in Figure 1.

Online courseware is the content that provides dynamically interactive learning materials and resources to students. The phrase "dynamically interactive" means that the design of learning materials should not only allow students interact with materials, but also allow interpersonal interaction during learning process.

Virtual classroom is the communication vehicle for students or users that allows them to interact to each other. Virtual classroom provides students and users the capability in making interpersonal interaction in Web learning environment. Ideally, virtual classroom should serve as the focal point for extensive collaborative activities, and that allows student frequently approach each other to exchange ideas, and show off what they have done and explain how they have done it to each other. In short, virtual classroom provides those who reside in Web learning environment an augmented reality of interpersonal communication. Empirically, the quality of virtual classroom will decide the acceptability of Pathfinder.

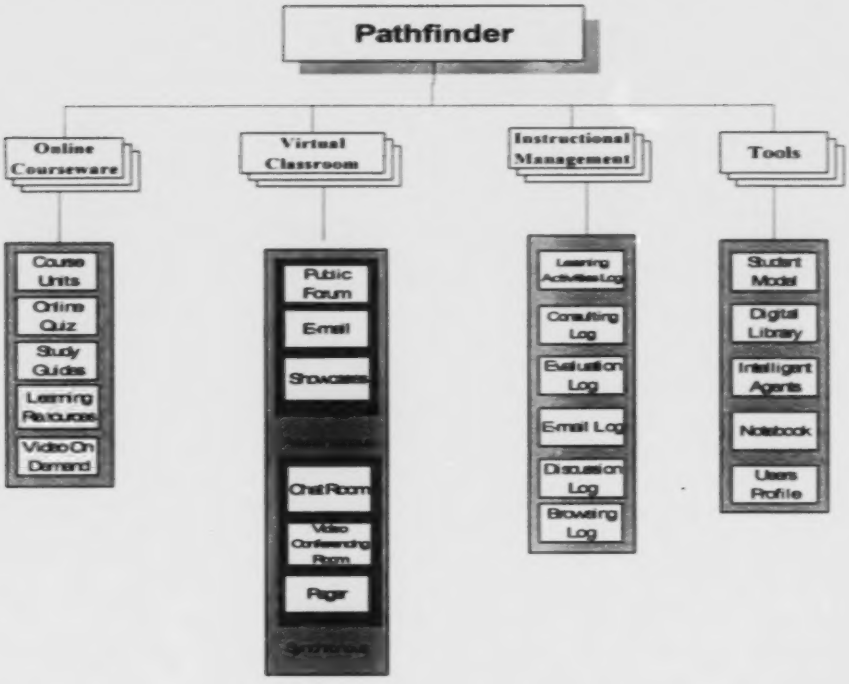

Figure 1. The Structure of Pathfinder

Instructional management is the system logging mechanism that keeps tracks of all the activities happen on the system. The log records could provide teachers and system managers the necessary information for the purposes of instructional management and evaluation.

Tools are utilities that aim at facilitating students' learning with system. There are three significant tools in Pathfinder which are student model, intelligent agents, and digital library.

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Digital Signatures for the Net

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Abstract: To help the Web reach its full potential, it is important that end users have a reliable mechanism that allows them to decide what Web content they can trust. These needs are addressed by the ability to attach digital signatures to on-line documents. This papers describes standard solutions for digital signature, with the focus on the Digital Signature Initiative project of the World-Wide-Web-Consortium.

1 Introduction

The Web has been gaining a lot of interest within the commercial community in recent years. Electronic Commerce has become a buzzword and will possibly lead to the Web becoming a common marketplace. Today, it is already possible to order anything from pizzas to cars over the net. In the future, shopping over the Internet could be just as normal as shopping at the supermarket; especially software is increasingly bought and downloaded online. In addition, electronic communication, using electronic mail, internet phone and other technologies, besides being a practical necessity among researchers as well as businesses, has become en vogue in the public.

Security has not been an issue with these technologies for a while. It still seems not to be a major concern for many users of these technologies, as the usage of secure electronic mail or SSL shows. This will without doubt improve in the near future, as more and more user client software offers these features to their users.
One major component of this kind of security are digital signatures, used for authentication and non-repudiation services. State of the art software for electronic communication more and more provide means to digitally sign documents or messages, and to some extend these are also used within browsers for mutual authentication between the client and the server. This paper presents the current status for digital signatures in the Web-environment, and presents newer developments in that area.

2 Digital Signatures

The basic technologies for digital signatures are well known [Schneier 1996]. Using asymmetric or public key-cryptography, the signer of a message could use his private key to encrypt the document, which is to be signed. The public key of the signer is assumed to be known to the verifier, or retrievable via certificates, ideally using the WWW. A verifier takes the public key and decrypts the encrypted document. Assuming that only the signer is in possession of the private key, the verifier knows that the signer indeed created the document.
As asymmetric cryptography is comparatively slower to compute than symmetric cryptography, one never creates a signature this way in practice. To sign a document, one calculates the hash of the document using a cryptographically secure hash function (examples for such hash-functions are MD5 and SHA-1). This results in a condensed representation of the message, which also is called *message digest*. This digest is now encrypted using the private key of the signer, providing a comparable level of assurance encrypting the full document would. The security of a digital signature using hash-functions is as strong as the weaker of the algorithms used for hashing and encrypting.

3 Usage of Digital Signatures in the Web

Digital signature technology is currently used in several standard-protocols and products, most importantly. This section introduces the most important standards or de-facto standards currently in use or under development.

3.1 S/MIME

S/MIME is a specification for secure electronic messaging, designed by several software-vendors in 1995 to

propagate a common standard. S/MIME is currently supported by major vendors like Netscape with their Messenger, Microsoft with Outlook Express and Outlook 98, SSE's TrustedMIME, Entrust's mail products, as well as others. Plug-Ins for Exchange or Eudora also exist from different vendors.
S/MIME is based on RSA's Public Key Cryptography Standards (PKCS), especially PKCS#7 (Cryptographic Message Syntax Standard –see [PKCS#7 1991]). PKCS#7 defines the syntax for several kinds of cryptographically protected messages, including encrypted messages and messages with digital signatures. It currently is the most widely used format, not only with electronic mail, but is also the basis for several other applications, like SET, the standard for secure electronic transactions from MasterCard and Visa, or PKCS#12, a standard for storing personal cryptographic information, as are keys or certificates.
PKCS#7 uses ASN.1 for encoding the protected messages and relies on a X.509-based certification infrastructure to work properly.

3.2 PGP

PGP has a longer tradition and was the first protocol for secure electronic messaging, that has been used on a large scale. Originally written by Phil Zimmerman, it was and still is freely available for non-commercial use since 1991. It not only supports secure electronic mail, but also provides security for all other forms of digital information, as telephony, fax, or image and video-communication.
PGP uses a proprietary format for it's messages. While the services S/MIME and PGP provide, are compatible, the formats are not. PGP also does not rely on a certification infrastructure, but on a web of trust, based on transitive mutual certification of end-users.

3.3 S/MIME versus PGP

From a security point of view, both S/MIME and PGP provide full scale encryption and authentication by basically using a comparable set of algorithms. There is a different philosophy behind the two concepts:
With S/MIME, as with all X.509 based concepts, trust between to users is formed by using common trust-points, which are a hierarchical system of certification authorities (CA). Most software also recognizes several existing certification authorities, like Verisign, thus relieving it's users from trust decisions they would have to make.
PGP's scheme is more anarchical, where originally no central authorities were planned and trust has to be decided on a case by case basis. There are, however, similar things in the real world, PGP-certification authorities, who sign other peoples keys. If a user decides to trust such signatures, there is not much difference between an X.509-CA and a PGP-CA.
PGP most likely still has the largest installed base of users, that are really using PGP for their purposes, even if S/MIME now is available to millions of users with Netscape's Messenger or Microsoft's Outlook. With an increasing awareness for potential problems, users of these programs might start using these features more widely, and S/MIME most likely will be the most widely used protocol in the future.

3.4 SSL

SSL - for Secure Socket Layer - is a protocol for secure electronic communication between two programs in the internet, like a Web-Server and a Web-Browser. While SSL has been defined by Netscape Inc. for use in the World Wide Web, it is not limited to Browsers and Web-Servers. SSL has been used with other protocols as well, like FTP or TELNET. SSL is currently the standard for transport layer security; it has been chosen as the basis for work with in the TLS-Working group at the IETF [Dierks and Allen 1997].
SSL does provide Authentication of Servers and Clients, i.e. a user can be reasonably sure he is talking to the correct server, and the server can base access-control-decisions on the ID of the user. Digital Signature Technology is used to provide this service. SSL does not provide digital signatures on the document level, however (to be precise, the content is not signed at all) and does not solve the problem of authentic documents.

4 The Digital Signature Initiative

To help the Web reach its full potential, it is important that end users have a reliable mechanism that allows them to decide what Web content they can trust. In particular, in two classes of documents public trust has become an issue: Active content (e.g. ActiveX controls or Java applets),and documents implying commitments (e.g. price lists, press releases, political statements). Both of these needs are addressed by the ability to attach digital signatures to on-line documents.
The World-Wide-Web-Consortium started a Digital Signature Initiative project to address this topic. It worked on a specification and an interoperable code base, an interoperability test suite and a public demonstration of the system.

It plans to allow the signature to be able to be transported in different ways; to have a common format for a signature block; allows for a systematic means for specifying the semantics of the signature, and it does not mandate a specific cryptographic algorithm nor a a single certification hierarchy.

4.1 Making signed statements about documents

The basic meaning of a digital signature, implicitly given by its nature, is "the signer had access to the signed document (at the given date)". This is also valid for S/MIME or PGP, where the content might give some additional hints, and in many cases does not. This meaning is often not sufficient as it does not become apparent whether the signer is the author of the document, if he wants to show his support for statements made in the document, or if he just wanted to acknowledge its receipt by signing it. Although there are sometimes conventions that make the meaning of the signature clear, the possible semantics are very limited. Therefore the need to extend the semantics of digital signatures became apparent and people began to talk about "signatures with semantics". Yet this phrase does not precisely state the requirements when signing documents. We do not really want to describe the meaning of the signature itself, rather we want to make statements about the document and guarantee their authenticity by digitally signing these statements. Therefore we need a way to describe the semantics of a document.
Luckily there is a standard that was designed for a similar purpose: PICS, short for Platform for Internet Content Selection, is a rating system that e.g. allows parents to restrict their children's access to the Internet so that they cannot access e.g. violent or sexually explicit material. It is a very flexible system, as it does not specify fixed categories in which content is rated, rather it defines a language that can be used to specify in which categories rating is performed. Therefore PICS, or something like PICS, could be used not only as a content rating system but also as a content description system, which is exactly what we need.
The World Wide Web Consortium, the primary promoters of the PICS-scheme, saw an immediate need for signed PICS-statements as well as a general solution to the above problem. In October 1996 the Digital Signature Initiative was launched. Ten W3C member companies supplied engineers and architects. In spring 1997, the first draft of the specification was published, specifying the use of digital signatures within a PICS-framework. In November 1997 this proposal became W3C draft recommendation and in May 1998 W3C Recommendation [Cho, DesAutels, LaMacchia and Lipp 1998]. Currently, several cipher-suites specification as well as a prototype implementation has been completed.

4.2 The DSig 1.0 Label

The DSig 1.0 Signature Label is a PICS 1.1 label with two extension options that contain the digital signature information. In this role, the PICS label provides both a means of transporting signature data and a simple framework for making machine-readable assertions. While DSig 1.0 does not meet all of the general design goals of the DSig project, it provides a substantial framework from which to build.
In its simplest form, the DSig 1.0 Signature Label is a signed statement about a specific information resource. If this information resource is fully named in the **for** option of the label (or implied by placing the label within the information resource itself), then a cryptographic link can be added in the form of the resinfo extension. In some situations, the information resource may not be fully referencable by a URL (Mailing list, dynamic page, generic label). In these cases, the cryptographic link can not be made in DSig 1.0. In either situation the label can be signed one or more times. At no time does DSig 1.0 'wrap' the information resource it is signing. The signed label can always be separated from the information resource.

4.2.1 Resource Reference Information Extension

The resource reference information (***resinfo***) extension provides an unambiguous reference to the information resource by adding one or more hashes of the information resource identified by the URL in the **for** option of the label. These hashes serve to further disambiguate the referenced information resource as well as provide a check of the resource's integrity.

4.2.2 The Signature-Block extension

The Signature-Block-Extension contains the digital signature itself as well as all necessary information to be able to verify the signature. As we wanted the Signature Block to be able to incorporate new cryptosystems, we use the well-known concept of 'ciphersuites' in form of Signature-Suites to refer to validated combinations of ciphers or hardware tokens and formats.

4.2.2.1 Certificates

As the Signature Block can contain all the data it needs to be verified, it needs to be able to carry associated certificates as needed. Carrying certificates doesn't imply normative dependence, though. There is nothing inherent in the cryptography of a digital signature that requires certification chains, so Signature Blocks, too, should be able to operate with opaque certificates. After all, certificates and other credentials are only there to establish trust in a key -- which is a trust management problem, not a digital signature problem.
DSig 1.0 defines X.509v1, X.509v3 and PGP-style certificates. The first prototype implementation will support X.509 only (see [CCITT 1988]).

4.2.2.2 Signature Suites

Being crypto-neutral, DSig does not prescribe the use of certain algorithms for hashing the data or signing the hash. Dsig also does not define a particular format for representing the cryptographic information in the Signature-Block. It uses the concept of signature-suites. This concepts bundles certain hashing-algorithms and signature-algorithms together, if the combination is considered safe.
<Signature-Suite> is an URL, that uniquely identifies the signature-suite used for generating the Signature Block. The specification of the properties of the signature-suite have to be retrievable using the given URL. If the signature-suite is a proprietary one, the URL need not point to that specification and serves only identifying purposes.
For the Signature-Block, we specify the format for some chosen, popular signature-suites in separate documents. This does not preclude the use of other combinations. The signature-suites a DSig-compliant implementation is required to support are specified in the DSig-Compatibility Document.
Each signature-suite

- specifies the algorithms that have been used for creating the signature-block,
- defines the content of the SigInfo-Block
- defines, if, and which information of the SigInfo-Block is hashed together with the data of the information resource
- defines, if, and which information of the SigInfo-Block is signed together with the hash in the private key operation,
- defines, how the public signing key is encoded in the Signature Block, if the public key is directly used in the Keyholder-Section,.
- defines, how the hash of the public signing key is calculated and encoded in the Signature Block, if the fingerprint of the public key is used in the Keyholder-Section,

For DSig 1.0, the following Signature Suites are defined:

- SHA-1 with DAS - see [Lipp 1998]
- MD5 with RSA - see [DesAutels and Lipp, 1998]
- SHA-1 with RSA – see [DesAutels and Lipp, 1998]

5 DSig 2.0

PICS was the first step, mainly aimed for child protection purposes. The ideas behind that concept were meanwhile taken a huge step further, by defining a framework for data about data, also called metadata. RDF – the Resource Description Framework (see [Lassila, Swick 1998] and [Brickley, Guha and Layman 1998]) – provides interoperability between applications that exchange machine-understandable information on the Web. It still can be used for rather simple applications, like rating systems, but it also could help to provide better search engines, when formal, machine-readable statements about web-content are available.
RDF with digital signatures will be key to building the "Web of Trust" for electronic commerce, collaboration, and other applications.
RDF has been specified in a Working Draft [Lassila, Swick 1998] and is likely to be the basis for the Digital Signature Initiative, Phase 2. As RDF is based on XML, the details of the specification definitely will change. The initial ideas will most likely hold. Up to July 1998, DSig 2.0 has not started, mainly due to the lack of resources at W3C. I hope to be able to give news and details about DSig 2.0 at the conference in November.

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Overcoming Conceptual Barriers to the Use of Internet Technology in University Education

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Abstract:

Recent government legislation has led to an upsurge in interest and debate over the use of Internet technology in university education. But how are academic staff being supported through this minefield of change? The aim of this paper is to outline the lessons learned in helping academics at the University of Strathclyde to bridge the skills gap for their future teaching and learning. The University has recently implemented an initiative to promote good practice in the development and use of new learning technologies to enhance teaching and learning. This paper explores how concerns voiced by academic staff were instrumental in developing strategies to overcome conceptual barriers to the use of Internet technology. This was achieved during the implementation of a skills development program at the University. This program includes workshops exploring pedagogical and practical issues, teaching skills development to faculty via the web, the creation of a community of scholars and providing consultancy to individual departments. The metaphor of the Clyde Virtual University *(http://cvu.strath.ac.uk/)* provided a conceptual framework on which academics could discuss and develop pedagogical issues.

1. Background

The potential for a major culture shift from traditional ways of educating students has been made possible by Internet-based teaching and learning methods, and further encouraged by government, university management and the expectations of students. For academics already struggling to keep up with increased administrative demands, teaching loads and research pressures, learning technology can be a formidable, time-consuming area to further sap their limited energies. At the University of Strathclyde in Glasgow, Scotland, faculty are involved in a program of skills redevelopment aimed at increasing the use of Internet technology in teaching and learning. The intention of this paper is to outline the successes and limitations of providing a skills development program at the University of Strathclyde. Based on our recent staff and educational development experiences we will discuss:

- skills development program - how Learning Technology courses were facilitated at the University of Strathclyde,
- barriers to using web-based technology voiced by participants on the courses,
- developing strategies to overcome these barriers,
- providing skills development to faculty via the web itself,
- future development - strategies required to increase the use of learning technologies in Higher education

2. Skills development program

Each workshop in this program is constructed around the learning environment of a virtual university. This provides a conceptual framework for academics to develop and use new learning technologies to enhance their own teaching and learning. The skills development program at the University of Strathclyde aims to promote good practice in the development and use of new learning technologies.

This is achieved by:

- running a program of skills development workshops,
- promoting dialogue through meetings and special events,

- providing individual consultancy to departments and providing resources to help academics use new learning technologies.

The program was piloted in the first semester of the 97/98 academic year and includes courses in:

- Choosing the Right Technology
- Electronic Assessment
- Web-based Teaching
- Electronic Libraries and
- Internet Communication.

These are usually full day workshops which are designed to complement one another, though this is not the sole focus. Faculty are initially invited to examine some of the educational issues involved in using the Internet for teaching and learning. Case studies are presented to illustrate these issues, showing examples of good practice where new technologies have truly enhanced teaching and learning. Wherever possible web-based materials, assessments and communication methods are used by academics themselves, placing them temporarily in the role of students and enabling them to evaluate the technologies at first hand.

Though practical training in the use of learning technology is provided to faculty during the classes, the focus is on the teaching and learning potential rather than on the technological potential. Staff are continually invited through the use of face to face and electronic discussions to think about how the technologies would best be used to enhance the student learning experience. Finally, through the workshops, academics are made aware of the various national and local services which are available to assist them in integrating the technologies into their teaching and learning.

3. Barriers to using web-based technologies

All classes are evaluated by anonymous online evaluation forms which allow the developers of the training program to assess its usefulness and to change the format and content in response to new requirements. From these forms and in class discussions we have developed a clearer picture of the perceived barriers to using new learning technologies. Some staff have expressed concerns about the lack of a suitable technical and organisational infrastructure for the implementation of these technologies; these can be relayed by the course organisers to senior management. Other barriers to the adoption of these technologies which the workshops aim to address include technophobia and a fear of dramatic increases in workloads. Furthermore, prior experience with educational technologies such as some CD-ROM packages has led to a cynicism among some staff about the educational effectiveness and the feasibility of implementing electronic teaching and learning on a large scale, though the potential of the web re-enthuses disillusioned participants.

Many of the reservations academic staff have about the new technologies were anticipated and dealt with during classes before they were voiced. For example, electronic assessment involving multiple choice type questions is often unsuitable for summative examination as Multiple Choice Questions fail to assess "deep" learning. Encouragement to students to communicate with their lecturers electronically can result in increased administration. Can the lecturers recommend new technologies to their students when they cannot provide personal, technical and administrative support?

Finally, some academics have limited conceptions about the use of the Internet for teaching and learning in advance of attending the program. They perceive that they might wish to put their lecture notes online and have no notion of a pedagogical basis for doing so. Perhaps they would like to recommend to students the use of the web as a resource for performing literature searches or to encourage limited dialogue by email. However, there is often no real conceptual framework of a learning environment on which to base their use of the WWW in teaching and learning. There is a degree of naivety with respect to new learning technology curing all of the perceived problems associated with traditional teaching and learning. If some academics have a poor grasp of pedagogical issues it is unlikely that they will overcome this simply by using different teaching methods.

3.1 Developing strategies to overcoming these barriers

At the University of Strathclyde, we perceived our skills development program as an excellent opportunity to overcome barriers to the adoption of the Internet for teaching and learning. This was achieved by using the metaphor of the Clyde Virtual University (CVU)1. The CVU is a virtual learning environment which integrates the main components of a traditional university setting. The Lecture Theatre is a home for web-based teaching materials, while the Library contains additional mainly textual resources. Students register for courses and find out about the virtual university in the Administration Office and take part in online discussions and virtual tutorial groups in the Virtual Café. Formative and summative assessments are found in the Assessment Hall. The simplicity of this model has found favour with academic staff throughout universities in the West of Scotland for whom assistance is provided in setting up web-based courses on CVU by project staff. Academics are able to review the learning packages, assessments and discussions groups currently delivered from the virtual university in their own and other subject areas before creating new materials.

The staff development workshops are designed around the conceptual framework of the Clyde Virtual University. Not only does this present academics with the notion of an integrated virtual learning environment, but it also provides them with an infrastructure to aid them in the construction of learning materials. The aim is to render the technology as transparent as possible so that focus can be placed on learning issues. Each workshop begins with a discussion of pedagogical issues, such as evaluating collaborative technologies [Sclater et al. 1998] or accommodating differing learning styles [Badcock et al. 1996]. In our experience academics can easily acquire practical skills such as creating online learning material using Netscape Composer. Using the CVU Test Wizard to integrate this primary course material with formative assessment and incorporating a HyperNews discussion in the Virtual Café adds a further dimension.

One of the workshops entitled Choosing the Right Technology provides an introduction to the other courses and gives faculty an overview of the learning technologies available to them. A major concern voiced was that existing materials, such as educational CD-Roms, promote surface learning. This is addressed by examining ways in which these materials can be integrated into the existing curriculum and, combined with more traditional, paper-based methods, can enhance teaching and learning. Some research behind the successes and pitfalls of integration has been documented by LTDI [LTDI Publications 1997], and is highlighted during a short on-line course. Staff have expressed that they enjoy being in the role of a student whilst reflecting on ways in which they could integrate the use of learning technologies into their own classes.

The significance of student dialogue was highlighted in a recent article by Terry Mayes in The Times' Higher Education Supplement [Mayes 1997]. Professor Mayes argues that it is essential to establish two-way communication: from teacher to student, then from student back to the teacher with the teaching giving effective feedback. Professor Mayes argues that current use of learning technology facilitates only one-way communication: from teacher to student. In the workshop on Internet Communication the importance of two-way dialogue is discussed with staff from both the University of Strathclyde and the Glasgow Caledonian University via a wide range of technologies including text conferencing, Internet Relay Chat, videoconferencing and shared whiteboards. Case studies have been very effective in illustrating innovative teaching methods. Two examples are the ICON Project [see Sclater et. al., 1998] during which students collaborated on a design project via the local Metropolitan Area Network and NetSem [Duffy et al. 1995] which was a music seminar carried out over the Internet.

The workshop focussing on Electronic Assessment has been made effective by blending pedagogical and practical skills. Participants discuss the most effective uses of electronic assessment in their classes, for example for formative assessment of large numbers of students. Focused on an effective use, participants can then utilise the assessment (*http://dora.cc.strath.ac.uk/david/work/ae/design/*) developed by the Clyde Virtual University team which enables them to rapidly create assessments even if they have very limited technological knowledge.

The Web Based Teaching workshop draws together skills required for web based course development with the practical issues of creating web pages. Academics are asked to bring some teaching material which they wish their students to use via the Clyde Virtual University. Despite their limited IT skills, most participants seem amazed at how quickly and easily they can create web pages. This allows them to concentrate on the underlying pedagogy. Increased use of the Clyde Virtual University means that there are even more educational websites with ideas to explore. A lecturer interested in putting teaching materials on the web may come away with an enthusiasm for developing assessment to be held in the

Assessment Hall. The realisation that the web can be used dynamically for discussions in the Virtual Café can transform an otherwise uninspiring series of online lecture notes placed in the Lecture Theatre.

As lecturers adopt more of the technologies into their teaching, the conceptual framework changes from that of a collection of isolated discussions, assessments and lecture notes. Courses can evolve into fully integrated learning environments with materials, activities, formative assessments, lists of frequently asked questions, discussions and summative assessments available from a single front end based on the course itself rather split up into the various areas of the virtual university.

3.2 Providing training courses to faculty via the web

One such course can be found in the CVU Lecture Theatre. Aimed at faculty within the University as well as undergraduate and postgraduate students, Advanced WWW Authoring allows participants to become proficient in using features of HTML such as frames and tables, as well as dabbling with simple JavaScript. This course can be taken by registered users of Clyde Virtual University as a stand-alone module but is also delivered as part of the staff development program at set times. Many staff, though able to take the course from their own desk, prefer to attend the scheduled class. Away from the distractions of their normal working environment, they can fully immerse themselves in the course with a limited amount of assistance from the course tutor and fellow participants if required.

The web-delivered course is introduced by the course tutor who ensures that participants have the basic computer and HTML authoring skills necessary to work through the materials. A recurring problem is the arrival of staff and students who have attended a previously scheduled course in basic web authoring but had no chance to practise their new skills. They are referred to online revision materials if this is the case. Some participants also have difficulty in adjusting to a course based entirely on the web and take some time to become familiar with the mode of study. There is a requirement to have three windows open simultaneously: the course itself in a web browser, a text editor enabling the entry of HTML and a secondary web browser to test the created web pages. A few less computer literate users have requested paper versions of the course materials; others have no difficulty toggling between the three windows.

Once satisfied that the participants are able to use the course, the tutor returns to his desk to work on other matters. From time to time, emails arrive in the tutor's inbox giving the results of the online assessments course participants are taking at the end of each chapter. Comments made in the course discussion forum also come in sporadically during the day. The tutor is thus able to build up a picture of how the participants are progressing with a minimum of attention. Later he returns to the lab to help users with problems they have not been able to solve for themselves. These problems are becoming fewer as groups of students highlight problems with the course which can be put right before its next scheduled delivery.

Online evaluation forms sent to the tutor at the end of this course confirm that most faculty are comfortable working in this way, though it is important to make clear to them at the start that the tutor is not going to be physically present for much of the day! Most participants check a box stating that they prefer a tutor to be around for some of the time rather than doing the course in complete isolation. Practical exercises throughout the course are rated highly, while quizzes at the end of each chapter are thought to be reasonably useful. Most users do not take part in the Hypernews discussions for each chapter and the general consensus is that these are not particularly useful. For the tutor, such comments as there are enable inadequacies in the course to be resolved. All users have commented that they would like to take future courses in this way; it is likely that we will develop further online courses and teach larger parts of the scheduled skills development classes via the web.

5. Future developments

Instead of a static and uninspiring medium for presenting text-based materials, courses designed for the virtual university can enhance communication between lecturers and students and between the students themselves. The need for dialogue and feedback as an essential part of the learning process is often lacking in existing teaching methods [Mayes et al. 1995], so this issue is stressed to staff attending the courses. The dialogue continuously encouraged during the workshops themselves provides opportunities for lecturing staff to experience the positive effect of two-way communication on the learning process.

Recent evaluation studies have shown that increasing numbers of academics are preparing to use new learning technologies to enhance their teaching and learning. The skills development program is only one of a series of initiatives, outlined earlier, to equip academics for this task. They have expressed a need to be supported by central services such as Academic Practice, Educational Systems and Audio Visual.

There is also an essential requirement to develop a community of scholars actively using these technologies. It is essential to retain the momentum and enthusiasm kindled during the workshops by promoting dialogue, debate and discussion. Therefore, after completion of a workshop participants are invited to add their names to a mailing list advertising meetings and special events. These include discussions of innovative methods of teaching and learning and seminars by visiting academics.

Another fundamental component of supporting academics wishing to use new learning technologies is to provide consultancy to individual departments. Presently at the University of Strathclyde many departments are developing strategies for implementing innovative methods of teaching, whilst some have secured funding for specific projects. It is important to offer informed guidance whilst embracing the individuality of each department.

As new communication technologies become widespread, it will be increasingly important for academics to have a clear understanding of teaching and learning issues and to acquire the necessary skills [Stefani et al. 1998]. To this end we are currently developing a Post Graduate Diploma in Advanced Academic Studies which includes two modules (at Scottish Masters level) in Web Based Teaching and Internet Communication. We hope to draw upon the lessons we have learned and further support academics to bridge the skills gap for their future teaching and learning.

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DESIGNING EFFECTIVE WEB-BASED INSTRUCTIONAL MATERIALS

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Abstract: This paper discusses the criteria for effective Web-based instructional materials. It bases the criteria upon the interrelationships between four elements in the instructional design process -- analyzing course participant characteristics , specifying course objectives, planning teaching strategy, and designing evaluation methods. The participant characteristics include those of the learners and those of the instructor. Course objectives must not only be achievable and assessable but also reflective of learner characteristics. Teaching strategy planning involves identifying technologies and designing good activities to facilitate critical thinking. Course evaluations should cover both program efficiency and effectiveness.

Distance learning has been increasingly practiced in higher education to extend learning beyond classrooms or institutional boundaries, to enlarge student enrollment, to meet a variety of faculty and student needs, and to enhance learning outcome. Web-based learning, with its low cost, easy access, convenience, and graphic interface, has become the fashion of distance education. Whether Web-based learning deserves the most popular choice of distance learning is a question to be answered. However, a far more urgent question for educators and educational developers is how to design effective Web-based instructional materials.

What are the criteria of effective Web-based instructional materials? The answer is, as I see it, that they must reflect conscious application of a systematic instructional design process. Kemp, Morrison, and Ross [Kemp, Morrison, & Ross 1994] state that there are four fundamental elements in systematic instructional planning: *learners*, *objectives*, *methods*, and *evaluation*. Smith and Ragan [Smith & Ragan 1993] divide the process of instructional design into three phases: analysis (of the learners, task, and context), strategy development, and evaluation. The two models agree that designing instructional material is a systematic process of answering who, why, what, and how. The same process should apply in the design of Web-based instructional materials.

In designing Web-based teaching and learning, we should analyze the characteristics of course participants including the instructor as well as the learners. Learner characteristics involve location, motivation, learning style, family or job duties, work experience, cultural background, computer skills, attitude toward computer-assisted learning, and accessibility of technology. Instructor characteristics encompass teaching style and teaching experience, family and other duties, attitude toward technology-mediated teaching, computer skills, and accessibility of technology.

Specifying objectives should answer such questions as "Why do the students take the course?" "What should the students learn?" and "What problem-solving skills should the students develop?" "Will the students be able to learn what they are supposed to learn?" In short, the objectives should be achievable and assessable. They should reflect the learner characteristics and be as objective as possible.

With the course participant characteristics and the course objectives in mind, we are in a good shape to plan teaching strategy. For Web-based learning, this stage consists of two phases: 1) designing methods of content presentation and activities to facilitate comprehension and stimulate critical thinking; 2) identifying suitable and effective technologies.

Presentation methods should vary to meet the different needs of course participants. No matter what form of presentation we employ, text only or multimedia, we should minimize linear presentation. We should branch content and context dynamically so that students can interact with the presentation. Appropriate use of non-linear multimedia applications, Javascripting, and Java Applets can help create interactive user interface, thus reducing boredom and keeping the learner interested. While some presentation of content is necessary, Web-based instruction must not be corrupted by tedious online lectures. Caution should be taken not to turn Web-based teaching and learning into mere explaining and comprehending [Ehrman 1998].

The most challenging part of Web-based instruction design lies in the planning of learning activities. Many course-related Web sites are typically utilized to post course syllabi, schedules, lecture notes, announcements, assignments, online exams, additional readings, and the URLs of related Web sites. Such Web sites are used simply for the instructor to post course-related information and for the students to retrieve such information. The success of Web-based learning, however, heavily relies on the depth of learner involvement, and on the opportunities for interaction and collaboration among the course participants. For learning to occur, we need activities that emphasize quality of understanding, encourage inquiry, and lead to transformation of facts. The characteristics of such learning activities are learner-centered and problem-based. Well-designed games can not only make learning fun but also engage the learner in critical thinking and inductive reasoning. Quizzes can provide the learner with instant feedback. Online group discussion is indeed indispensable in Web-based learning because it is the fastest avenue for the course participants to identify problems, exchange ideas, and collaborate in the learning process.

What technologies should we use in a particular Web-based course? It depends on the characteristics of the course participants as well as the availability of technical support. Currently, there are good design tools such as FrontPage Editor, PowerPoint, Director, PhotoShop, and RealMedia applications. At the University of Kansas Medical Center, all the faculty are expected to be able to use FrontPage Editor and PowerPoint, while the educational support technologists assist with instructional materials using graphics, sound, animation, or video clips. On the student side, ideally, they need easy, fast access to the Web via a browser with all the cool plug-ins. In most cases, they do have access to a Web browser with multimedia capabilities. If the students are inexperienced with the technologies that they have access to, it is advisable to include a technical tutorial on the course site.

How do we use technologies effectively? Technologies should be used with valid purposes: to facilitate and enhance learning, and to create a pleasurable and interactive learning environment. Technically, a good Web page design should provide: 1) easy navigation from page to page and within the same page; 2) consistency (color, font, background, basic formats, graphics, navigation tools) between pages within a site; 3) good text and background contrast; 4) meaningful combination of text, graphics, sound, and animation; 5) reasonable page length (usu. 1-2 printed pages); 6) absence of distracting animations, blinks, and irrelevant graphics; 7) observation of copyright law.

The final stage of Web-based instructional designing is the planning of evaluation methods. If a Web course is involved in a research project, formal evaluation instruments should be designed and implemented. In other cases, evaluation questionnaires may suffice. At present, like traditional courses, most Web-based courses only employ a course evaluation at the end of a semester. For Web-based courses, especially brand-new ones, evaluations or assessments should be conducted throughout the course so that timely revision can be made to increase effectiveness and efficiency. The evaluations should cover both program effectiveness and program efficiency. Program effectiveness can be measured in terms of the achievement or underachievement of program objectives, whereas program efficiency can be assessed in terms of time, costs, and technical support required for achieving the objectives.

In conclusion, designing effective Web-based instructional materials is a systematic planning process that consists of four stages: analyzing course participant characteristics, specifying course objectives, planning teaching strategy, and designing evaluation methods. The criteria of effective Web-based instructional materials lie in the close interrelationships between the four fundamental elements.

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Web Response Time and Proxy Caching

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Abstract: It is critical to understand WWW latency in order to design better HTTP protocols. In this paper we characterize Web response time and examine effects of proxy caching on response time. We show that at least a quarter of the total elapsed time is spent on establishing TCP connections with HTTP/1.0. We also characterize the effect of a user's network bandwidth on response time. Average connection time from a client via a 33.6 K modem is two times longer than that from a client via switched Ethernet. Contrary to the typical thought about Web proxy caching, this study finds that a single stand alone proxy cache does not always reduce response time. Implications of these results to the HTTP-NG protocol and Web application design also are discussed in the paper.

1 Introduction

Recently, in an effort to design the next generation HTTP protocol (HTTP-NG), the W3C group initiated a wide range of Web characterization studies. In the HTTP-NG activity statement they stated "It is important to understand the actual system and how it is being used before attempting to optimize it." [W3C 1998] Though many studies have been characterizing Web traffic, little is known about the characteristics of Web latency. While Web proxy caching is widely used in the Web system, little is known about the effectiveness of proxy caching. Characterization of Web response time will help understand the nature of WWW latency and give guidance to designers of Web system applications and HTTP-NG.

Research on the effectiveness of proxy caching is very active. A study at Virginia Tech has shown that hit rates of 30% to 50% can be achieved by a caching proxy [Williams et al. 1997]. However, one study found that Web resources change frequently and suggests that a simple cache may be of only limited utility [Douglas et al. 1998]. In this study, we explore the effect of speed of network connection and using proxy caching on latency. Specifically this study will answer the following questions:

- What kind of distribution does response time follow?
- Does proxy caching improve response time?
- How does response time change with different levels of traffic?
- What is the effect of network bandwidth on response time?

Connection time is defined as the time between when a browser tries to establish a TCP connection to a Web server or proxy server and the first byte is received by the browser. The transfer time

is the time between when a browser receives the first byte from a Web server or proxy server and the browser receives the last byte. Elapsed time is equal to connection time plus transfer time.

2 Experiments

Five experiments were conducted in the study. The first four experiments were run using two variables, each at two levels. See Table 1. The first factor, bandwidth, reflects the type of network connection between the the browser and Internet. The second factor, Proxy Cache, is either none, where the HTTP queries are sent directly to the original server, or one, where the HTTP queries are sent to a proxy cache, which then sends them directly to the server.

Each of the first four experiments consists of replaying four HTTP log files using Webjamma [Johnson 1998]. See Table 2 for a list of the log files for 4 workloads considered. In the proxy caching experiments, we used a modified version of squid 1.1.6.

Webjamma replays a workload by reading a log file of URLs, sending HTTP queries, and timing the transfer. Since Webjamma just discards the transfered data, the only delay is from the transfer. Webjamma maintains a configurable number of HTTP requests in parallel.

In the fifth experiment we vary the number of parallel Webjamma processes accessing the proxy to simulate different load levels on the proxy server. In this experiment, we use a subset of the VT Campus workload.

Table 1: Variables and levels used in the study

Variable	Low level	High level
Bandwidth	33.6K modem	Switched 10baseT Ethernet
Proxy Cache	None	One

Table 2: Workloads used in this study.

Workloads	Periods	Total Accesses
`America Online`	Dec 1 (40 minutes), 1997	825,602
`Boston University`	Jan 27 to Feb 8, 1995	522,928
`VT Campus`	Sep 28 to Oct 5, 1997	696,975
`VT Library`	Sep 28 to Oct 5, 1997	1,014,875

3 Response time without a proxy

The four workloads were replayed, recording the connection time and elapsed time. Average connection time ranged from a low of 0.27 to a high of 0.54 seconds. Average elapsed time ranged from a low of 0.57 to a high of 1.98 seconds. The ratio of average connection time to average elapsed time ranged from a low of 0.27 to a high of 0.69. In all workloads, this ratio is higher than 0.25, indicating that at least a quarter of the total elapsed time was spent setting up the connection. Although HTTP/1.1 supports persistent connections we found that most of the HTTP transactions in our VT Campus network were HTTP/1.0 transactions (about 89% still use HTTP/1.0). This may be one of the reasons why this ratio is high.

Table 3: Average connection time, elapsed time and ratio of connection time to elapsed time

Workloads	Connection Time	Elapsed Time	Ratio
American Online	0.54	1.98	0.27
Boston University	0.39	0.57	0.69
VT Campus	0.27	0.73	0.36
VT Library	0.32	0.88	0.36

Note: All times are in seconds

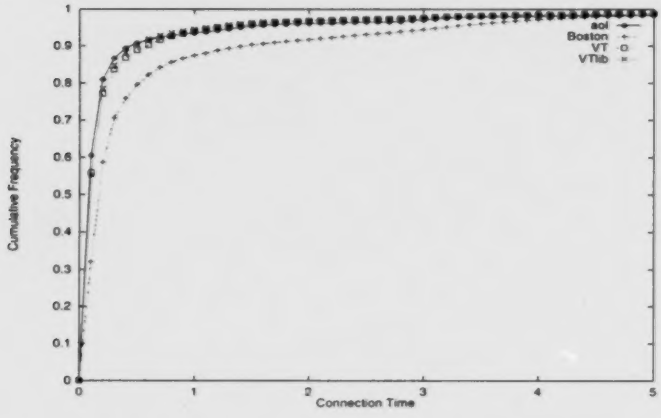

Figure 1: Cumulative Distribution of Connection Time

Figure 1 and 2 show that over 80% of the time the connection time and the elapsed time are less than one second. Table 4 lists the connection time given various cumulative frequency values. The results show that 99% of time, connection time is less than 10 seconds. This result suggests that a Web client's default timeout value should not be higher than 10 seconds. It is found that

Table 4: Connection time for various cumulative frequency

Workloads	90%	99%	99.9%
American Online	0.90	9.69	22.56
Boston University	0.62	5.14	14.12
VT Campus	0.40	3.74	13.98
VT Library	0.46	4.53	22.58

Note: All times are in seconds.

all of the above response times follow Pearson distributions except the cumulative distribution of connection time of VT Campus workload follows Weibul distribution.

4 Response time with a proxy

The second two experiments were then performed, replaying the workloads through a proxy server this time to quantify the performance changes due to proxy caching.

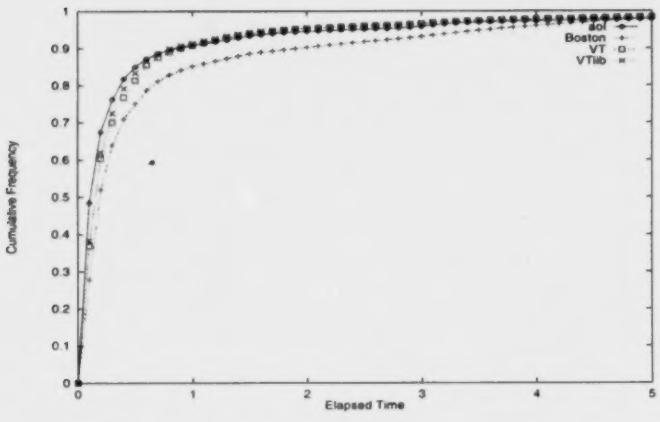

Figure 2: Cumulative Distribution of Elapsed Time

Table 5: Response time of proxy caching using VT Campus workload

Network Connection	Average Connection Time	Average Elapsed Time	Ratio of Connection Time to Elapsed Time
`switched Ethernet`	0.47	0.86	0.54
`modem`	0.87	2.50	0.35
`ratio`	1.85	2.89	N/A

Notes: All time is in second

Contrary to our expectations, Table 5 shows that with the proxy the connection and elapsed times are longer than those with no proxy for both switched Ethernet and modem connections.

5 Response time and proxy traffic loads

In this experiment, the number of parallel Webjamma processes ranges from 1 to 90, and the corresponding completed requests per second range from a low of 0.65 to a high of 20.83. The results are presented here.

Figure 3 shows that response time increases with an increase in the number of parallel Webjamma processes (equivalent to an increase in the request arrival rate). When the number of parallel Webjamma processes exceeds 50 (equivalent to 16 requests per second or 1.38 million requests per day), the response curve becomes steeper. This result shows that proxy server performance is sensitive to traffic load and as it becomes overloaded the performance will degrade quickly.

6 Effect of network connection on response time

To examine the effect of network connection on response time, a subset of the VT Campus workload was re-played using two different network connections: PPP via a 33.6 K modem and switched 10baseT Ethernet. Table 6 lists the average response time and elapsed time from the experiment. In the Table 6, all time are in seconds, and the ratio is defined as the response time via a 33.6 K modem divided by the response time via switched Ethernet.

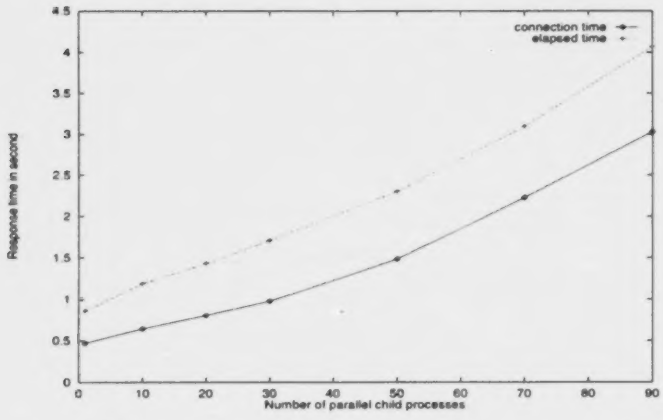

Figure 3: Response curve of response time to proxy traffic load

Table 6: Response time with different network connection

Network Connection	Average Connection Time	Average Elapsed Time	Ratio of Connection Time to Elapsed Time
`Switched Ethernet`	0.27	0.73	0.37
`33.6k modem`	0.59	2.33	0.25
`Ratio`	2.21	3.19	N/A

Average connection time from a client via a 33.6 K modem is 2.2 times longer than that from a client via switched Ethernet. Average elapsed time from a client via a 33.6 K modem connection is 3.2 times longer than that via switched Ethernet connection. Although Table 6 shows that end user network connection speed has a significant effect on response time, we expected the difference in performance to be higher. This shows that there is a fixed delay introduced in both cases from servers and network load. It is found that connection time via modem follows a Log-logistics distribution and elapsed time via modem follows a Pearson distribution. Table 7 lists the connection and elapsed time given various cumulative frequency values.

Table 7: Response time of modem users under various cumulative frequency

Response Time	90%	99%	99.9%
`Connection Time`	0.79	4.46	13.12
`Elapsed Time`	4.67	20.09	59.85

Notes: All time is in second.

7 Recommendations

Based on the above results, we give the following recommendations:

- For both low speed modem users and users via switched Ethernet, 99% of the time, connection time will be less 10 than seconds. This result suggests that the Web client timeout

value should not be higher than 10 seconds.

- Speed of network connection has a significant effect on the connection time. Average connection time from a client via 33.6 K modem is two times longer than that from a client via switched Ethernet. In both switched Ethernet and modem cases, connection time is at least a quarter of the total elapsed time. Contrary to Touch's result [Touch et al. 1996], our study suggests that even for modem users, migrating client to HTTP/1.1 browsers can achieve a significant response time improvement.

- Simple proxy caching does not always reduce response time. For switched Ethernet users, connection time with the proxy is 1.8 times longer than with no-proxy. For modem users, connection time with proxy is 1.5 times longer than that with no-proxy. Average elapsed time with proxy is a little bit longer than that with no-proxy for both switched Ethernet and modem users. The proxy caching should be better designed, and relevant HTTP protocol changes regarding proxy caching should be made. We found in the proxy log file over 10% accesses are "not modified" (304 status code). Proxy can be designed to allow for a distributed model to validate cache contents and hence "conditional Get" will not be necessary.

- In our experiment, when traffic load is above 16.7 requests per second, performance of a proxy degrades quickly. It shows that the performance of a proxy caching server is sensitive to proxy loads. For a proxy server, arrival rate should stay below a suitable threshold in order to achieve acceptable performance.

8 Acknowledgments

Members of the VT NRG provided helpful comments on the manuscript. NSF grants CDA-931261 and NCR-9627922 partially supported this work. IBM donated the equipment used to collect the traffic log files.

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The Loneliness of the Long Distance Learner — Using On-line Student Support to Decrease the Isolation Factor and Increase Motivation.

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Abstract: One of the factors causing decreased motivation (and student drop out) amongst distance learners is that of isolation. Frequent student/tutor contact is a most important factor in student motivation and involvement. Learning is enhanced when it is collaborative. Students who socialise with their peers are less likely to drop out and are more likely to maintain high levels of motivation.

Isolation and motivation

"Distance learners are usually isolated from other learners", which means that motivating forces of a 'social' kind (competition, gain or loss of status, fear of looking foolish, peer pressure) are absent (Cropley & Kahl, 1983)."The role of motivation in distance education cannot be overstated" (Zvacek, 1991).

Traditionally decreasing this sense of isolation has been difficult. Study groups can be set up, but often students are at great physical distances from each other so this becomes expensive and difficult. Tutor/student communication is often also limited by cost factors, and if it is primarily by telephone as it is currently at The Open Polytechnic, the contact person is not always available at the time the student telephones (although voice mail helps here).

Student drop-out

The causes of drop-out from distance education are complex and interdependent. Tinto's (1975) model of student persistence has been particularly influential in the analysis of student drop-out rates. He cites a number of variables which influence this, three of which are: poor achievements at school; poor social integration (with other students, tutors and administrative staff); and lack of contact with the learning institution. He sees an analogy with Durkheim's (1961) theory of suicide and suggests that students are more likely to drop-out if they are not integrated into society — in this case, the society of the learning institution. "Collective affiliation between student and institution can be enhanced through any of the channels of communication between the two: through the package of study materials; via academic support; or through administrative support systems" (Kember, 1990). At the Open University (UK) it was found that drop-out was less likely in courses using multiple media (Peters, 1992). The latest study at FernUniversität (ibid.) found that the main reasons for drop-out included: preference for on-campus study (31.4%); lack of social contact with other students (27.3%); and more support from the institution expected (13%).

"There is wide general agreement that entry levels of education play a significant role in retention and success, particularly in the first year of enrollment. Those with lower entry levels are at a greater risk, requiring more structured programmes and more tutor support". The 60% plus drop-outs from a first year course are highly unlikely to ever re-enrol in distance education programmes (Lilly, 1998). This would suggest that priority be given to supporting first year courses.

On-line support project

"The on-line learning environment is particularly appropriate for collaborative learning approaches which emphasize group interaction . . ." (Harasim, 1989). Bates, 1995, says of his experience with on-line learning that it "had a revolutionary impact on some students and teachers alike, radically changing the learning context from one of a centrally controlled, hierarchical approach to learning, to one where at least some students not only fully participated, but to some extent took over the communication network to meet their own learning and social needs".

The current project at The Open Polytechnic aims to increase student motivation and collegiality by providing student support, and both tutor/student and student/student communication in course specific areas on-line.

The Open Polytechnic web site (http://www.topnz.ac.nz) already provides a number of elements of student support. These include on-line library access for enrolled students (to the library catalogue, learning resources and other databases), other on-line learning resources including guides for study skills, essay writing skills and exam techniques and email access to tutors.

This project will provide each course or area of study with its own 'mini-site' which will provide course specific resources for the student. The aim is to support 20 courses in the first year of the project.

On-line support resources include qualifications, Unit Standards, cross credits/exemptions, timetable information, fees and enrollment information, subject detail, career options, news pages, FAQs, tutor information, course related research and external links.

Each area has its own listserver to facilitate increased student/tutor and student/student communication and socialisation. The list messages will be archived to the 'mini-site'.

Evaluation will be by student feedback via email — to the tutor regarding content and functionality, and to the webmaster regarding any technical issues.

Here are some sample student comments from evaluations of on-line courses run by The Open Polytechnic:

"I feel more part of it with the listserver — like a class — not so distant — as opposed to other courses, which I did previously — It's easy to get off track otherwise. I checked my mail every day — when its active it gets you involved, new concepts come up, and you're motivated. I think it will make a huge difference to distance learning in the future.

"Yes — found this (the listserver) very useful — like being in a class, people asked questions and you could see what the answers were"

Funding

The Open Polytechnic currently receives a proportion of its funding from Government. The formula for this is based on projected enrollments (of EFTS — Equivalent Full Time Students). However, in its 1997 Green Paper, the Government has indicated a possible change to funding based on completion (retention) rates making it imperative that maximum rates be achieved. Currently overall retention rates at The Open Polytechnic range between 45–49% (Lilly, 1998).

The Student Support Project, outlined above, will assist to decrease drop-outs and increase retention rates by increasing student motivation and satisfaction and decreasing the isolation factor.

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Learning Studio: Design Solutions for a Virtual Learning Environment

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Abstract: Available web based collaborative learning tools fail to provide environments for dynamic group interactions. Based on research in the areas of distributed cognition and collaborative learning we have developed a prototype of a web based, 3D/VR powered collaborative learning environment that we refer to as Learning Studio. Issues emphasised in the design are social awareness, knowledge creation and management and group process support.

Collaborative Learning: Peer Interaction and Knowledge Construction

Given the expected enhancement of computing power and network performance two to three years from now, we assume the widespread use of multimedia 3D/VR conferencing systems to be feasible. Based on a simplified model of collaborative learning we developed a prototype of a web based collaborative learning environment powered by DIVE [Carlsson and Hagsand 1993], a platform for multi-user virtual environments.

We believe that for the deployment of successful networked collaborative learning at least two things are needed: a supporting environment and good instructional design [Bourdeau et al. 1997]. In order to design a virtual learning environment we needed an appropriate pedagogical learning model. Working in close co-operation with pedagogy researchers and taking advantage of results from CSCL (Computer Supported Collaborative Learning) research, [Koschmann 1996] and research in distributed cognitions [Salomon 1993] we have come to base our design work on the learning model depicted in [Fig. 1].

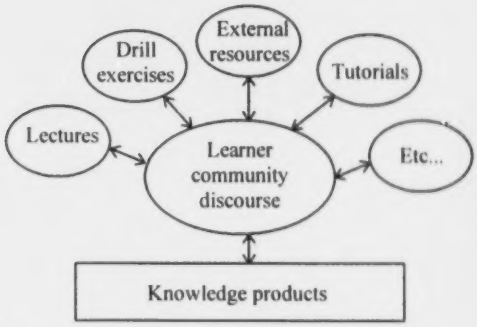

Figure 1: Collaborative learning model.

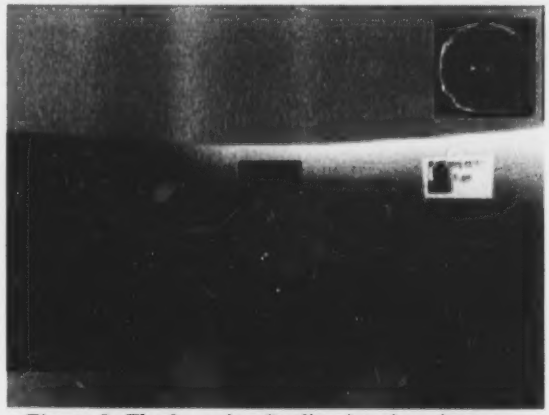

Figure 2: The Learning Studio virtual environment.

The core of effective collaborative learning is meaningful interaction between peers. The peer discourse aims at the social construction of knowledge and objectified knowledge products. Learning aids adopted from time to time to "seed" the learning environment with new information and to set the pace and direction of the learner community discourse include lectures, tutorials, drill exercises, etc.

Design Solutions for Group and Information Awareness

Effective networked collaborative learning requires multimedia communication coupled with application and data sharing. These tools usually require a great deal of cognitive effort from the users. Management of windows on the screen and constant interpretation of often numerous graphical screen elements draw attention away from the task at hand. Research suggests that 3D virtual environments can provide support for natural communication skills by implementing part of the spatiality of real life group interaction [Benford et al. 1994]

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The metaphor used in Learning Studio is a *dedicated project room* [Greenberg and Roseman 1998], i.e. a room dedicated to a specific group and time frame during which people can work together with shared information and tools available in the room. Artifacts can be left in the room between sessions and users come into and leave the room seamlessly. Every user is represented by a human-like avatar. Entering the room means entering into a multiparty spatial audio conference with all the other participants. Always being within "hearing distance" from the other participants ensures that informal communication is not unnecessarily hindered by e.g. difficulties in locating or setting up connections to the other participants. Though all participants always share the same room, we still wanted them to be able to form smaller groups and have the ability to work privately while still being present in the environment. To achieve this we used the work-desk or table metaphor in order to create "rooms" without walls within the main room [Fig. 2]. Every table represents a personal or collaboration space where documents and tools can be invoked, created, organized, edited and stored for later retrieval. The ability to spatially organize artifacts and documents on the tables, on noticeboards, whiteboards etc also serves the purpose of high cognitive accessibility through recognition of artifacts and interpretation of the spatial organization of artifacts. This increases the awareness of the status and progress of activities in the virtual environment.

Design Solutions for Effective Interaction

Effective peer interaction has to be staged through good instructional design for collaborative learning. A number of pedagogical techniques can be used for that purpose, such as role-play, brainstorming, jigsaws, case studies etc. Advanced groupware tools, e.g. GroupSystems from Ventana Corp support several of these group processes, but are complicated to learn and often require an expert process leader. In Learning Studio, group process support is implemented as lightweight distributed tools that are easy to learn, closely integrated in the environment and provide a minimum of features, so as not to put unnecessary cognitive load on the participants while they engage in the actual interaction task. Another important aspect is that teachers or instructional designers should be able to author, or stage, these group exercises as easily and as flexibly as handing out photocopied notes and directions scribbled down the evening before class. With Learning Studio we can so far demonstrate two different group process tools: a chat based role-playing tool and a Java based collaborative mind-map tool. The mind-map tool differs from the role-play tool in that participants will use it more generically in different parts of the learning task. Other desired generic tools are e.g. a scribble whiteboard and a brainstorming tool, while examples of tools that require authoring by the instructional designer are debates and case studies.

Design Solutions for Knowledge Creation and Management

Objectification of knowledge is a central part of our learning model. We propose a simplified model of knowledge consisting of a problem or question based structure of information, such as documents, and analysis of the information with regard to that problem or question. In Learning Studio, KnowledgeViews are used to structure and organize links to different kinds of information files, comment types and analyses of these files. Each KnowledgeView is built around a question or problem and the group can collaboratively reorganize the structure and content of a KnowledgeView. KnowledgeViews are not just containers for file storage, they are rather meant to live, evolve and die, all the time reflecting the current state of the group's discourse around the problem in focus.

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Available web based collaborative learning tools fail to provide environments for dynamic group interactions. Based on research in the areas of distributed cognition and collaborative learning we have developed a prototype of a web based, 3D/VR powered collaborative learning environment that we refer to as Learning Studio. Issues emphasised in the design are social awareness, knowledge creation and management and group process support. The prototype was developed using DIVE, a platform for multi-user virtual environments, developed by SICS, the Swedish Institute of Computer Science.

A VITAL Consortium: A Collaborative Faculty Support System for Web Course Development

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Abstract: This paper outlines an approach, to help university faculty integrate technology into the teaching and learning process, implemented at the University of South Florida. USF's approach involves the creation of a VITAL (Virtual Instructional Team for the Advancement of Learning) consortium. VITAL combines the expertise of existing campus resources and provides the vital services and support necessary for faculty interested in technology-enhanced teaching. The result is evident in the proliferation of courses using the World Wide Web as a medium for delivery at USF. Because of VITAL, faculty members have become empowered with all the knowledge and resources available to a large university community.

Introduction

Few would argue that Web-based instruction is proliferating in university environments. More and more courses and programs are being offered either partially or entirely via the Web. This trend has created a major shift in the teaching and learning paradigm. To effectively make this shift, additional support is necessary for faculty. This paper outlines the approach implemented at the University of South Florida. USF's approach involved the creation of a VITAL (Virtual Instructional Team for the Advancement of Learning) consortium. VITAL combines the expertise of existing campus resources and provides the vital services and support necessary for faculty interested in technology-enhanced teaching.

Background

The University of South Florida (USF) is a public university with a diverse student body of over 35,000 students. In order to meet the instructional needs of students (both on campus and through distance learning), USF faculty and administration recognized the importance of integrating technology into the teaching and learning processes. They also realized that in order to expedite changes in the learning model, the university needed a faculty support structure to provide assistance on technical issues, instructional design concerns, and delivery options.

In early 1997, the following objectives were identified by a university-wide technology committee:

- Increase remote student access to course materials via the Web
- Increase integration of technology in courses offered on campus
- Increase online collaboration (teacher/student and student/student)
- Increase the number of courses offered via distance learning
- Increase student FTE generated via distance learning
- Increase use of the Web for course management and support

- Increase modeling of effective use of technology by faculty in university courses
- Decrease frustration level of faculty seeking support for development of instructional materials
- Expand course resources via materials and databases available at remote Internet sites

Establishing VITAL

After careful consideration of the options for fostering professional development, the technology committee recommended that a virtual unit be established that would combine the resources and expertise of existing units. In September, 1997, the VITAL (Virtual Instructional Team for the Advancement of Learning) consortium was formed with representatives from the following university units:

- Academic Computing
- Center for Teaching Enhancement
- Florida Center for Instructional Technology
- Educational Outreach / Distance and Technology Mediated Learning
- Health Sciences Center
- USF Libraries
- WUSF-TV

By contacting any member of the VITAL consortium, faculty can obtain the specific type of assistance and support they need. For example, personnel from Academic Computing (programmers and technical experts) work with personnel from the Florida Center for Instructional Technology and Educational Outreach (instructional designers and graphic artists) to support faculty in the development of course materials that can be delivered via the Web. The Center for Teaching Enhancement coordinates workshops that are conducted by members of all units, and the Library assists faculty in incorporating online resources (such as full-text journals, databases, and electronic reserve) into their course materials.

To facilitate access, VITAL members can be reached through a Web site (http://www.usf.edu/vital), an e-mail address, and a single telephone number. As the "calls" arrive, they are funneled to the appropriate VITAL unit. In some cases, the faculty needs can be met by one VITAL member; in other cases, several members collaborate to collectively address the support or service issues.

Initial Results

In the first nine months, the impact of VITAL has been phenomenal. Numerous professional development efforts have been conducted in both formal and informal environments. Using the Web to deliver instructional materials has become increasingly efficient and effective. USF has obtained licenses for several software programs that provide an architecture for online courses, including WebCT, TopClass, and Web Course in a Box. Over 150 courses are planning to incorporate some degree of online instruction in the Fall of 1998, 15 using Web Course in a box, 26 using TopClass, and 115 using WebCT.

Concluding Remarks

VITAL is a consortium of separate university units who are working together to foster the integration of technology into the teaching and learning process. The result is evident in the proliferation of courses using the World Wide Web as a medium for delivery at USF. Because of VITAL, faculty members have become empowered with all the knowledge and resources available in a large university community.

Through regular meetings, the members have shared their goals, accomplishments, and frustrations. This increased awareness has helped to replace competition with cooperation, and it has served to provide an efficient and effective support structure for USF faculty. As the infusion of technology reaches into all facets of university life, new models are required to meet the new demands. The ability to work together on common ground is paramount. The key to the consortium's success lies in the true spirit of cooperation that exists between its members

Using Interactive Computer and Internet Lab Exercises with Freshman Biology Students

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Concerned with the increasing computer ability incoming freshman, a program was developed to engage students in self-directed laboratory exercises. The freshman biology class was selected because of high enrollment on campus

The program using HyperStudio as the base allows the student to go to the web, follow their lab manual, then return to the computer for an assessment. The assessment will allow the student to continue only after selecting a correct answer. This allows the student to explore the lab concepts on the web and computer before actual hands-on in the laboratory occurs.

Data for the study were collected from students taking the first semester Biology 101 course during the academic years 1994 through 1997. The first three years were used as the control group and the 1997 data were used as the experiment. This produced significant results, $F=8.575$, $df=3/704$, $p<.05$.

Visual Constructor: Remote Authoring in a Web-based Learning System

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Abstract: It is generally recognized that the Internet and the World Wide Web can be used as a platform to deliver web-based learning services. For instructors, the Internet provides shared access to resources and media-rich materials to augment traditional instruction. However, the main barrier for publishing the courseware on the web is the difficulty of the authoring process. It is not easy for the instructors without technical knowledge to create and organize web contents. We have been developing an authoring tool, Visual Constructor, to help people jump over this hurdle. It provides templates and form-based interfaces for course page layout and web documents. A tree map is used to represent a logical view on the organization of the whole course. These approaches greatly simplify the authoring work and allow the course authors to modify the contents anywhere through a web browser.

1. Introduction

The exponential growth of the World Wide Web (or web) has resulted in a large and growing number of people with access to the information on the Internet. Due to its popularity, many different applications and services such as news, stocks and shopping have been delivered and published through the web. It is more and more popular to put course materials on the web by taking advantage of this trend in corporations and educational institutes. Both instructors and students benefit from this evolution. The instructors can distribute the electronic materials from their desktops. It is also easier for the students to access the course services at home or a computer lab.

A core problem in providing web-based distance learning service is the production and integration of the course materials. Since this process is complicated and very time-consuming, most of the instructors are too busy to learn authoring tools to design the courses and post them on the web. They do not have time to arrange the links between the documents or design the interfaces for the materials. It is also almost impossible for the course authors to manage the real files on the web server machine, especially while they do not have enough knowledge for computers and web technology. Obviously, there is a need for easy-to-use authoring tools to motivate the instructors to quickly produce web-based courseware.

We have been developing a web-based authoring environment, Visual Constructor, to overcome the problems in creating the course contents. The main purpose is to make the process of production as simple as possible. The followings are the goals we want to achieve: (1) This environment does not require of authors any knowledge of the evolving web technology including HTML(HyperText Markup Language), CGI(Common Gateway Interface) and web server. (2) The user interface is easy to understand and operate. Point-and-click, and filling in the necessary information are the main operations. (3) It is a web-based remote authoring environment so that the course authors can use a web browser to accomplish all the tasks at any location. (4) The course authors do not need to worry about the physical files. The system automatically manage the source files on the web server. The webmaster can also easily identify and manage the files if necessary. (5) The information can be updated or modified for the evolving course content.

The organization of the paper is as follows. Section 2 describes the related work. Section 3 introduces the methodologies and underlying approaches in Visual Constructor. The authoring process through the easy-to-use web-based interfaces is also illustrated using an example. In section 4, we explain how the course is presented and navigated in the learning environment created by Visual Constructor. Section 5 concludes the paper and discusses the future work.

2. Related Work

It is generally recognized that the web can be used as a medium to deliver educational services. Many institutes and research groups have been using the web to construct distance learning environments on the Internet[Lee et al. 1996][Ibrahim and Franklin 1995]. Different mechanisms can be applied to improve the viewing experience. For example, some works have used hierarchical structures to navigate web documents for general or educational purpose. Hauck puts arrows with different directions in web pages to indicate the next locations the user can traverse to [Hauck 1996]. Lai and colleagues [Lai et al. 1995] design a tree-like overview map for students studying the course materials.

Several projects are related to authoring for different purposes. An independent tool [Carver and Ray 1996] running on a local machine has been developed to organize different types of media under a hierarchy to form a digital library. A couple of HTML templates are used to generate the course interfaces. The tool Web-CT [Goldberg et al. 1996] has been built by the University of British Columbia, Canada. It provides a hierarchical view for the organization of the physical files in a course. ANDES system was designed for management and delivery of distance education courses by considering the network bandwidth [Johnson et al. 1996]. Girgensohn [Girgensohn and Lee 1997] integrated java-based dynamic form into the web to accomplish some sophisticated requirements for form layouts. Quint created a structured document editor in which the user can have different views on a HTML document based on a formal expression of the document [Quint et al. 1995]. Some related commercial tools are also available, such as TopClass by WBT Systems (http://www.websystems.com/whitepaper/) and Asymetrix's Learning Management System (http://www.asymetrix.com/products/). TopClass provides the remote authoring capability. However, the customization of the page layout is limited. Asymetrix focuses on varieties of tools on a user's local machine. Contigo Software (http://www.contigo.com/ 21features .html) developed a java-based software, Itinerary, to deliver real-time PowerPoint presentation over the Internet.

3 Authoring Environment

This section describes the authoring environment in Visual Constructor. We first described several methodologies in the system design. Then, the organization of the software modules which are implemented according to the methodologies is explained. Finally, the authoring process is illustrated using an example.

3.1 Methodology

To develop a user friendly authoring system to attack the goals described in the first section, we have come out with several underlying methodologies which form the basis of Visual Constructor. Basically, templates and a logical view for a course provide the instructor easy operations by isolating the complicated physical process. Based on these ideas, the authoring flow can be simple and smooth for the course authors.

Course Layout Templates: A course should have a unified layout for the students to navigate through the courseware. For example, a table of contents of the course can be put on the left-hand side of the layout to represent the course structure. The main advantage of showing the structure can improve the traversal experience during which the students do not get lost. However, instructors may have different preferences. Some of them may think that it looks better to locate the structure in a frame on top of the web page. Hence, various templates are provided for different kinds of layouts to satisfy some degree of customization. Each template includes a set of HTML files with only the layout skeleton. Whenever a document is created, the system adds structural information into the skeleton. The resulting HTML files reflect the new structure.

Document Templates: Some documents for a course must be available on-line to provide students complete information, such as syllabi, assignments, announcements, lecture notes and reference materials. Each type of document usually has some typical information, for example, the course title, the instructor's name, and the teaching assistant's name in the syllabus. The template for each type of documents is embedded into the system. The interface of each template is a form on which the course author just needs to fill in the necessary contents. The system will transform the input into a web page according to the HTML skeleton. By taking advantage of the concept of the document template, the author's input and operation for creating a document are minimized. The modification or update of a document is also simple by changing the old content of the form.

Logical View: We want to guide the authors to construct the course in a structural way. Instead of

considering what kinds of documents need to be provided, they start by building a logical structure for the course first. By following the thinking on the overall picture of the course, then the necessary material can come out and be organized. Hierarchical structure is usually the most natural way to present the organization of the documents, such as table of contents and computer file systems. Rohrer summarizes that the popular approaches to visualizing a hierarchy are tree maps, cone trees, and hyperbolic browsers [Rohrer and Swing 1997]. We adopted the tree maps since the 2D layouts are easy and simple to create and traverse.

Physical File Management: It is difficult for the course authors to manage the physical course files, especially when the number of files grows more and more. These files have different purposes, such as announcement and discussion, or contain various types of media, such as video clips and java programs. Putting them together in an organized way may be complicated. Visual Constructor provides automatic and invisible physical file management by making use of the concepts of templates and the logical view. The tool leads the course authors to operate the courseware always on the logical view and templates. This mechanism isolates the authors from the underlying physical changes. Under this control, the mapping and consistency between the logical view and the physical files are maintained. Another advantage appears since there is no broken-link problem for the documents inside the system. The link consistency is assured by the tool.

3.2 Software Modules

The hierarchical software modules of Visual Constructor is illustrated in [Fig. 1]. The two modules under Visual Constructor, Administration and Authoring, execute the two major functionalities, course management and course authoring, respectively. The Course Archive module provides the catalog of the available courses. Only authorized person can log on the class archive site to manage or author the course. The Administration module uses the Course Archive to display the course list for the system administrator. It deals with the creation and deletion of a course by touching the physical files of the course. For example, after a course is added, a physical folder is created and located in the web server. Authoring module utilizes Course Archive, Course Layout and Course Update to select a course and achieve authoring process for the course authors.

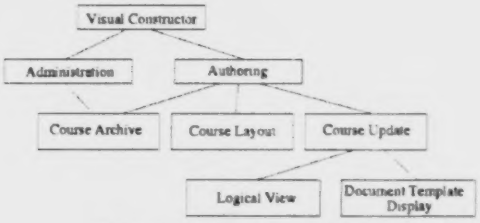

Figure 1: The Software Modules

The Course Layout module provides a form to get user's preference. It combines the preference and the course layout template to generate the necessary HTML files for the skeleton of the web page layout. The Document Template Display module also uses forms to simplify the process of data input. Then, this module mixes the document template and user's input into a web document in HTML format. The Logical View module draws the tree map according to an internal tree specification. It also coordinates the previous two modules to make the course layout structure and the documents consistent. The following is one example of the tree specification in XML (eXtensible Markup Language) [Khare and Rifkin 1997] format. The reason why we adopt XML is its nature of representing a tree. By using the standard format, this tool may catch the evolution of the web for making the documents structured and may add knowledge into the web contents.

```
<frame name=disp> </frame>
<folder name= title=csci1005>
<mainpage name=mainpage.html title=mainpage> </mainpage>
<syllabus name=syllabus.html title=syllabus> </syllabus>
<folder name= title=Lecture1>
<SLIDE name=Slide1.html title=Slide1> </SLIDE>
<SLIDE name=Slide2.html title=Slide2> </SLIDE>
<GUIDED_LECTURE name=video1.html title=video1> </GUIDED_LECTURE>
<SLIDE name=Slide3.html title=Slide3> </SLIDE>
</folder>
</folder>
```


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3.3 Authoring Flow

We would like to focus on the operations for course authoring and to demonstrate how easy it is to manipulate the course web site. The course authors do not need to pay attention on the consistency between the structure and the documents. For example, when a lecture and its slides are created, the resulting table of contents still matches the current organization and contents. The services for interaction can also be easily set up and configured. without any advanced technical knowledge, such as script languages, java, and web server configuration. One example is used to illustrate the authoring flow.

Figure 2: Configuring the Course Layout

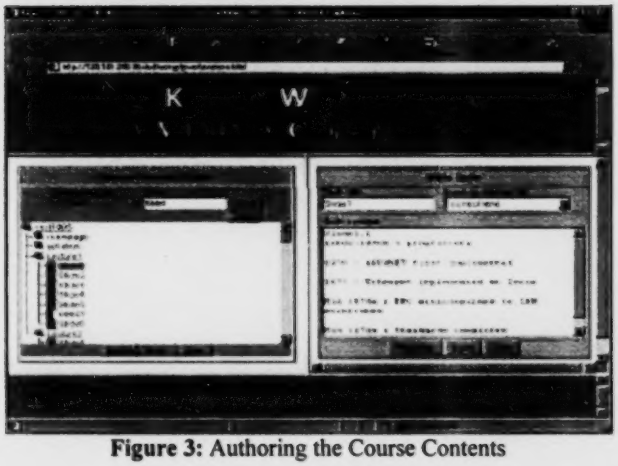

Figure 3: Authoring the Course Contents

Suppose that David is teaching a computer science class, e.g. csci1005, for the spring quarter, 1998. After the administrator adds csci1005 into the course archive, the instructor can log on the system and start to build up the course web site from scratch. The first thing is that David needs to think about what the course web page will look like. He selects an interface according to the course layout template. [Fig. 2] depicts the user interface for the first step. The sample of the layout on the left-hand side gives him the idea what the result will be. He can enable some of the available service modules, select background images, etc. He can preview the outcome for further adjustment before the selection is done.

Then, David can continue to add contents into csci1005. This process may prolong for the whole academic term since the course materials are augmented gradually. The interface for this process is demonstrated in [Fig. 3]. The left-hand side frame in the middle contains the logical view in a tree map. The instructor can add or delete a node. Each node is a folder or a leaf depending on its type and corresponding template. For example, a lecture is represented by a folder since the instructor expects to add more information into that. On the other

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hand, a syllabus is a stand-alone document. After Double-clicking on a leaf, David sees the form with some blank areas. What he needs to do is to fill the areas, preview the result page, and then the document is created and integrated into the web site. Now the class web site is ready for students to browse!

4 Learning Environment

In this section, we would like to demonstrate a web-based learning environment which provides multimedia presentation and interaction among students, teaching assistants and the instructor. All of the web interfaces are created by Visual Constructor. There are three major features. First, this system gives a structural front-end so that the students can easily navigate the course contents. Second, several service modules are integrated in this environment to provide synchronous or asynchronous activities. Then, the video-on-demand feature is supported to enable a presentation flow on the web.

Figure 4: The Layout of the Course Web Page

Structural Layout: [Fig. 4] illustrates one example of the web page layout created by Visual Constructor. It is possible to have different layout structures in this authoring system. There are four separated areas implemented in frames. The top frame shows the logo for this course or the institute. The right middle frame (title frame) has the course title and lists some of the service modules. The left-hand side frame (toc frame) gives the structure of the course documents, like a table of contents. The right bottom frame (display frame) is used to display the information. The course hierarchy is represented in the toc frame like a table of content. The students navigate the hierarchical structure on this frame and read the contents on the display frame if necessary. For example, the top most layer includes all the lectures. Under each lecture, there are possibly slides, video clips or other reference materials.

Service Modules: Some services are employed in this system to improve the interaction among the students and the instructor. These services in this example include discussion forum, on-line chat room, office hours, on-line quiz and a virtual laboratory. The discussion forum provides asynchronous communication in which the people can post or reply messages. A private discussion forum can be formed for several students with security protection. They can use the area to coordinate team work and accomplish a term project. An on-line chat room service supports synchronous activity such that students can share messages and a white board in real time. The office hour shows the time table of the office hours of the instructor and teaching assistants. A video conferencing tool can be linked with each office hour if the equipment or software is available. The on-line quiz is another feature through which the students can evaluate their understandings and the instructor can collect students' performance. Finally, virtual laboratory is one of our java-based projects for the education of computer networks [Lee et al. 1997]. It demonstrates that Visual Constructor can support different customized service modules.

Presentation Flow: The learning system also couples with a video server to provide video viewing. A video server is developed to deliver pre-stored video streams, such as recorded lectures, to learners at different locations through the networks. By integrating the video server and the course material on the web, the students not only can study off-line, but also enjoy high-quality lecture video and experience the in-class presentation. The synchronization between the video and slides is under development based on our previous works [Schnepf et al. 1996][Ma et al. 1998]. The slides automatically change to match the pace of the video. Beyond that, a slide-driven synchronization can invoke the corresponding video clip while a student selects a specific slide.

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5 Conclusion

In this system, we provide the learners an integrated environment to navigate the documents, interact with other people and view the multimedia presentation. Due to the tremendous need for an easy-to-use tool for creating the course web site, the remote authoring tool, Visual Constructor, has been developed. It helps the authors to organize the documents from a tree view. A variety of service modules is also supported. The most important contribution is that the tool isolates the activities on the physical files from the course authors so that it makes authoring much easier and user friendly. We believe it is able to encourage inexperienced instructors and teaching assistants building a class web site. We continually take advantage of the web and state-of-art technologies to enhance the system. Part of the implementation using CGI is in the process of shifting to java programs. There are more templates coming up for different types of course layouts and web documents. We are also improving the presentation flow by synchronizing the streaming video and lecture slides.

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Issues of Student Diversity and the Use of Technology in Higher Education : Resistance is Futile

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Abstract. The current emphasis on technology in higher education has focused on the dreams and future benefits to institutions and students. Ideally, the infusion of technology into college and university courses causes a pedagogical paradigm shift from a teacher-centered orientation to a student-centered orientation. However, the current teaching and learning "Zeitgeist" within institutions and the readiness of faculty and students have been overlooked. This short paper begins to delineate the varied issues that institutions of higher education need to address in order to increase student and faculty utilization of technology and the Internet.

The endurance of technology and a future of increasing utilization of technology within higher education are well known. Asynchronous, distributive, and distance learning have become avenues to reach more students and to reach those students who have difficulty coming to a campus for traditional instruction [Brown & Duguid, 1996]. As class sizes increase and government resources dwindle, technology is being integrated into more traditional on-campus courses in order to provide students adequate student-student and student-instructor interaction. Technology is also helping universities address the larger societal demand to be in tandem with the increasing technological sophistication and focus on team and workgroup collaboration present within business and industry [Marshall & Glover, 1996].

Ideally, the infusion of technology into college and university courses causes a pedagogical paradigm shift from a teacher-centered orientation to a student-centered orientation. The use of e-mail, newsgroups, listservs, discussion and chat forums are being used to increase "community" by facilitating student-student and student-faculty collaboration and interaction. Students who are generally shy in a traditional classroom are becoming more active participants in the educational experience [Karrayan & Crowe, 1997; Pardee, 1996]. They now have the capability to collaborate and interact at their own pace and within their own timeframe. However, in order to appropriately infuse technology into courses and to enhance student learning and critical thinking abilities, courses must be redesigned, rethought, and restructured. After all, the important issues are about teaching and learning, not technology [Laurillard, 1996].

While the emphasis on technology in higher education has focused on the dreams and future benefits to institutions and students, the current teaching and learning "Zeitgeist" within institutions and the readiness of faculty and students have been overlooked. The general populace within the United States is fast becoming more technologically literate, yet there is still a great amount of variability in the amount of computer literacy. Many incoming college students still need basic instruction on using computers, word-processing, and the use of e-mail, let alone use of the Internet. As the mean age of undergraduate students increases and the student population becomes more diversified in terms of age, social class, and ethnicity, the variability in computer literacy becomes even greater. For many the issue of fear or technological phobia can have a composite of personal, social and/or cultural origins. In addition, fewer and fewer students reside on-campus or have convenient access to college or university technology laboratories. This creates the added burden of basic access.

Today's college students differ not only in terms of their basic computer literacy, but also in terms of the capacity to interface with the academic environment and their own personal/developmental maturity. In traditional courses a certain amount of attendance at a structured time and place is required for academic success. However, as many faculty are quick to point out, many students lack the personal discipline and maturity to come to class at a physical setting complete with its sociocultural milieu of demands and expectations of teachers and classmates. On the other hand, in technology enhanced courses, attendance at a structured time and place is lessened and replaced by virtual, on-line computer interaction, unstructured by time and place. Independent and reflective learners thrive in this environment. However, how many students are mature enough to independently take the time to access the technological requirements of the course when teachers and classmates are not immediately present? Furthermore, as Howard Gardner, David Kolb, Daniel Goleman, and others have discussed at length students differ in terms of their intellectual nature, learning style, and emotional intelligence.

To take full advantage of technologically enhanced courses, students are required to independently learn and understand, explore, and create. While the basics such as e-mail and word-processing are now part of the learning environment in which university students participate, there is wide variability in the number of students who have been motivated, nurtured, or encouraged to be active participants in their own learning and understanding, let alone to be explorers and creators. To fully benefit from technologically enhanced courses students should have the capability and the self-efficacy needed to search for information, evaluate information, and utilize information in accord with accepted academic/intellectual standards. According to most developmental models [e.g. Piaget, Perry, Maslow, Kegan] these capabilities represent higher order thinking patterns.

The definition of student diversity is further expanded to include the issues of motivation, financial difficulties, access to on-campus resources, issues of discrimination within group as well as societal, and work/family problems. It can no longer be assumed that students are motivated to interface with the academic environment in the first place. Today's typical university student has a personal agenda of which academics are only one part. With the rising costs of higher education, students have pronounced financial concerns. The number of non-working, full-time students has diminished dramatically. Most of today's college students work at least part-time. With the median age of students rising, many students also have families of their own. Between work, family, and personal obligations, little time is left for school. In turn, for many colleges and universities, especially those in large urban areas, there is an increase in the enrollment of students from lower socioeconomic groups.

Resistance to technology is futile on the part of administrators, students, or faculty, nor would it be advantageous or noble! Yet in order to be successful, universities must be able to confront the basic issues at hand. This includes the tremendous diversity present in today's student population plus the teaching and learning Zeitgeist that is present within the institution. The institutional Zeitgeist must address not only the amount of technology present within the institution and issues of access, but also basic issues of teaching and learning as well as the level of support and reward for the faculty to address these basic issues of teaching and learning using technology.

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A Web Process Support System For Distributed Working Groups

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Abstract: Geographically dispersed software environments usually have different characteristics, knowledge and technologies. It is very hard to manage the activities, the deliverables, and entire software process itself. We propose a Web system to support software processes for distributed working groups. It facilitates the elaboration, organization, and presentation of the software components in the form of hypertext. The Web can be used to improve the state of art in computing, changing the way software applications are developed, maintained, tested and improved.

1. Introduction

The quality of software products is directly related to the software process that is used to develop them [Curtis, Kellner and Over, 1992]. Many enterprises invest in technology and training to support software practices. Nevertheless, CASE tools and sophisticated equipment do not guarantee the quality of software deliverables. A well defined and managed software process allows not only the quality improvement of their products but also the enhancement of productivity.

Nowadays, the Internet is used worldwide and offers the possibility to develop projects among distributed working groups. The communication is electronically supported and data is easily shared. However, in heterogeneous and geographically dispersed environments, the groups usually have different characteristics, knowledge and technologies. It is very hard to manage the activities that are being performed, the deliverables that are being constructed and entire software process itself.

CERN (European Laboratory for Particle Physics) is one of the world's largest scientific laboratories and an outstanding example of international collaboration of its nineteen member states and some observer states. Such a characteristic contributed to the World-Wide Web conception, which initial goal was to allow that high energy physics could access data anywhere in the world in an uniform way but, nowadays, its objective is much more wider [WWW Consortium 1998]. The ATLAS (*A Toroidal LHC ApparatuS*) detector of CERN brings together more than 1700 collaborators from 144 universities and research centers. The software development will require approximately a thousand professionals per year, where 85% corresponds to small groups that do not work at CERN [ATLAS 1996]. Within large collaborations, the interaction of specialists from different domain areas is highly significant. These professionals have to communicate their decisions and coordinate their activities. We propose a Web system to support software processes for distributed working groups. It is being developed under the CERN (European Laboratory for Particle Physics) and UFRJ (Federal University of Rio de Janeiro) collaboration.

2. The Web Process Support System

The Web Process Support System for Distributed Working Groups goals are: to guide the software construction, to define activities and deliverables, to coordinate and structure the information that is held during the development process and to stable the communication among the working groups by storing decisions taken. The system is a set of information management mechanisms where data are stored in a net of nodes, connected among them. The navigation mechanism allows a fast access to different detailed levels of a software project. The user understanding enhances due to high quality interface, which integrates software components. Within software environments, the amount and complexity of data complicates the identification and creation of relationships among several documents [Biebier and Kacmar, 1995]. Therefore, the use of advanced Web technology allows the implementation of an independent, flexible, transparent, and interactive software

development platform, meeting the needs of large collaborations. The Web system foundation is based on the definition of a software process, which is then, used by dispersed working groups.

The system is composed by several modules. The main one is the **Software Process Configuration** that presents a standard process and allows the instantiation of a suitable software process. The **Activities Record** presents all tasks that should be performed and the deliverables to be constructed. The **Documentation Generator** module produces hypertext files, which correspond to the overall software process. The **External Documents** links any kind of information in the Internet with the software project under development. Through the **Inconsistencies Report**, the user is informed about incomplete tasks. The **Decisions Taken** registers all decisions taken during the software process and the items to still be implemented. The **Components Record** module stores the software components and related links to their representations at different abstract levels. An electronic mailing mechanism is integrated to the other modules through the **Communication** module, which allows sending messages to all members of the working group and automatically registering the mails. Any software data can be easily found through the **Information Search** engine.

The architecture is composed by a relational database and a set of mechanisms to structure, create and modify software components. The system was developed using the Web technology and the advantages offered by the browsers. The server interfaces with the database through CGI programs, which are implemented in C language and shell scripts under a Unix platform. The use interface includes HTML forms and JavaScript programs to locally validate input data and avoid network communication traffic.

Within the system, the activities of the software process and the resulting products are linked together through a hypertext guideline. A software component representation can be textual or graphical, horizontal (same level of abstraction) or vertical (from the concept to its implementation). The Web system supports a conceptual transformation chain that progresses from initial artifacts (e.g. software requirements) to intermediate ones (e.g. architectural design) and then to the final product, the software product itself. The system designer can use cross reference information to make sure that the interactions at a particular level of abstraction meet the requirements and constraints imposed by the higher levels of abstraction. The system maintainer also can use the information to see how a change in representing or implementing a concept will interact with other concept representations and implementations. The software project manager can use cross reference information to certify that all requirements were respected and not forgotten.

3. Conclusions

The production of quality software systems with a reasonable cost is a challenge to social and economical needs. The improvement of productivity and product quality does not happen only with the introduction of technology. The software process is an important factor and so, it is necessary to define consistent and suitable processes to then select tools and methods to support the execution of the process activities [SEE 1997]. We presented an example of a worldwide collaboration, exemplifying the need for defining a controlled software process. The great interconnection among machines fostered by the Internet allowed programs to be dispersed developed and widely used. The Web system has the objective of supporting software development performed by heterogeneous, geographically distributed, cultural and technological different working groups. All modules offer mechanisms to coordinate and to support software process tasks and integrate software information through hypertext links. The proposed system facilitates the elaboration, organization, and presentation of the software knowledge in the form of hypertext. The Web can be used to improve the state of art in computing, changing the way software applications are developed, maintained, tested and improved.

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Interactive Multimedia Learning and Teaching - Why and How

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Abstract: This paper presents a framework for setting up a system to deliver on-line learning and teaching materials via the Internet, with enhanced rich-text, graphics, video-on-demand, interactive revision or self-test exercises, synchronous and asynchronous chat groups, and a quality monitoring mechanism.

Introduction

This paper explores the development process of a government-funded project to develop a computer aided learning system incorporating video-on-demand technology in the Department of Building and Real Estate. The background information, rationale, pedagogical consideration, information technology and presentation style will be presented. A small case study will also be presented. Lessons learnt and recommendations will be given in the conclusion. The on-going development of this system has taken into consideration of a new Master of Science program in Project Management by distance learning to be launched.

Why Interactive Multimedia Teaching and Learning?

Background

The idea of incorporating video-on-demand technology in computer aided learning stemmed from several strands:

- difficulty in explaining construction processes with traditional methods
- students find it difficult to visualise these processes
- increasing impractical to organise site visits due to large class size and tight teaching schedule
- advancement in technology, e.g. digital video and video streaming

Pedagogical Objectives

To be complete, the delivery of teaching materials cannot be simply video recordings. A number of pedagogical considerations and objectives are required. A *multimedia* and *interactive* teaching and learning suite for delivering *content-rich materials with interactive revision, quality monitoring and administration* is to be developed. This system can be characterised by having:

- self-access and self-paced learning;
- multimedia, i.e. rich-text, graphics, voice, video-on-demand;
- interactive mode, i.e. question and answer sessions between the user and the computer;
- quality monitoring, i.e. a record and report of who has done what, when and how well for review by both the teacher and the learner;
- administration, i.e. teachers are able to add, update and delete materials in the system easily without too much technical assistance and/or intervention;
- synchronous and asynchronous discussion or chat groups between users and teachers;

Qualify Assurance and Monitoring

An important feature of this system is the ability to record progress of students over time. A student can review his/her scores over time and the teacher can review all students' scores. The score distribution among questions is

also available for the teacher to review the relative difficulty of the questions so that remedial and/or additional materials can be provided.

How?

Information Technology

The video-on-demand system was developed on a local area network. The following hardware and software is involved in the project:

- a SGI video streaming server capable of delivering 50 streams of MPEG1 video
- an Oracle Enterprise server and an Oracle Web server
- switched fast ethernet connection to servers and switched ethernet connection to workstations
- a NNTP server for discussion groups

Impact and Significance

In our situation, at least 260 students can directly benefit from this project. 300 more students undertaking similar subjects in courses such as civil engineering can also use the material for learning, due to the similarity of content in different courses. Students' awareness and understanding of a wide range of construction techniques, previously one of the most difficult areas, will be enhanced. Other impacts include the increase in the amount of current video material of the construction industry in the Hong Kong context. The resultant product and methods can be used as a prototype and adapted to other subjects that have scope for visualisation, role-play, and self-directed learning. The project intends to apply and integrate leading edge technologies such as Video-on-Demand system, database, the Web system, and a LAN-based system in teaching and learning. With the cabled TV technology and other emerging broad band technologies such as xDSL, some of which is available in Hong Kong, the idea of integrating live video in on-line learning materials can be delivered to homes.

Observations

Firstly, the interactive multiple-choice questions proved to be highly effective in reinforcing students' understanding of the fundamentals. Secondly, video recording of actual construction processes and operations is primarily process oriented. An example is *concreting*. The video shows how concrete is mixed, placed, and cured. On the one hand, the video provides students with a vivid scene of what concrete is and how it is placed, etc. On the other hand, it does not show how one element relates to other elements within a building structure. For example, it does not reveal how the building's loading is transferred from floor to columns and then pile cap and eventually to the piles resting on bedrock. Therefore, there is a need to develop other applications, in addition to video, in order to make on-line teaching complete. Thirdly, the use of HTML to present course materials has its limitation. It was found that formatting the materials in PDF, which was used by some teachers, was surprisingly good especially for course materials with a lot of graphics. Students also welcome PDF as they only need to download one file without having to worry about missing pieces of graphics.

Conclusions and Recommendations

The idea of including true multimedia into learning materials has been realised. Now rich-text, graphics as well as live video can be integrated into a learning environment. With the aid of computing technology, self-access self-paced learning, both as a aid to learning and studying and as a distance-learning mode of studying, can be done. Database-Web link allows authenticating users, providing interactive and iterative dialogue-type interface between users and the computer, recording and analysing students' performance as a means of continuous quality control and monitoring.

In conclusion, it is considered that video-on-demand fulfils many of the criteria needed of an on-line teaching and learning system, in particular in the construction and real estate areas. Although this system provided us with a leap forward in the use of multimedia for teaching and learning, other supplementary and complementary tools are required. Virtual reality modelling is considered to be highly desirable in the fields of construction and real estate.

Using Web-Based Resources and Intranet to Advance K-16 Technology Adoption and Collaboration

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Abstract: Using the Technology in Education Model (TEAM), the *Partners In Learning/SchoolNet Prototype* in the Talawanda City Schools, Tri-Village Local Schools, and Miami University in southwest Ohio is positioned to advance and offer developmental insight on teacher and administrator network, telecommunity, and curriculum development as well as education technology adoption at both the pre- and inservice levels. Outcomes to date suggest that web- and Intranet-based telecommunities, properly installed and professionally developed, can: (1) have a transformative impact on the culture of teaching and learning; (2) be effectively used to provide and host a rich array of curriculum and publishing opportunities; and (3) serve as a critical component of a K-16 approach to the adoption of education technology.

Introduction

In the state of Ohio, four current state technology initiatives, *SchoolNet*, *SchoolNet Plus*, *Telecommunity*, and *Schools on the Move* have been funded. Combined, the four programs represent a $1,000,000,000 commitment by the state and service providers to infuse technology into K-12 education and set the stage for cultural transformation of teaching and learning in Ohio. Moreover, if these initiatives are to enjoy widespread adoption throughout the state, it is critical that colleges of education and K-12 schools collaborate to develop a K-16 approach to pre- and inservice teacher education in the area of education technology. The Technology in Education Adoption Model (TEAM), developed at Miami University, recognizes the importance of this approach to professional development and this paper describes how the TEAM model has used Intranet, web-based K-16 resources, and telecommunity to encourage the adoption of education technology.

Curriculum Development

Talawanda City Schools and Tri-Village Local Schools, both involved in *Partners in Learning*, an *Ohio SchoolNet Prototype*, are also collaborating districts in Ohio's *Schools on the Move* project. The goal of this project is to design a technology-supported curriculum that improves fourth and eighth grade proficiency test scores. These two districts, along with Miami University, were selected because their intact *SchoolNet* infrastructure could produce information on the impact of telecommunity-supported curriculum development. Unlike other participating schools, we developed a web site for constructing *LessonLabs* that can be authored, edited, and shared across districts and teachers. In addition, other schools from around the region and state have begun to use the site. Results to date suggest that more frequent, timely, and cost effective communications are occurring between project participants than in other areas of the state where *SchoolNet* infrastructure has not been installed.

Summer *SchoolNet* "Playshops" have also been designed to provide authentic opportunities to improve current instructional activities and to extend curriculum design into more advanced technology-rich activities. Consistent with ACOT research [Sandholtz, Ringstaff, & Dwyer 1997], teachers have sought first to improve their current practices and then pursue more advanced applications and activities that employ available technologies. Moreover, a curriculum bank developed in the "Playshops" is stored online on Talawanda's FirstClass Intranet Server and teachers have reported accessing this resource for ideas on how to integrate technology into their instruction. Perhaps most exciting is that these same teachers can use the "Chat" or simple e-mail features of FirstClass to contact the author of the curriculum idea for clarification and suggestions. In

contrast, the chance of a classroom teacher contacting the author of a textbook is almost nonexistent. As teachers use these *SchoolNet*-based resources and engage in professional development opportunities to enhance their teaching with technology skills, they also become better able to mentor preservice teachers, both in person and online, who are learning to do the same in university environments. This is the component of teacher education programs that is usually missing, but which is critical to training preservice teachers to use technology as tools for learning [OTA 1995].

Professional Development

The professional development plan has been guided by a "Teacher Leader model" that emphasizes voluntary, personalized, and developmentally sensitive training and curriculum development. Teachers are encouraged to participate, but not required to do so. Two consecutive two-week summer "Playshops" have attracted over 60% of the project's 280 teachers who participated in team building and online simulations conducted over the FirstClass telecommunications (Intranet) network. High school students were hired to provide technical support during the summer "Playshops" and remain part of the "Tech Squad" during the academic year. The Tech Squad sets up and makes minor repairs on computers, solves problems through a "Help Desk" on FirstClass, documents teacher competence gains, and helps identify emerging technology needs. In fact, this systemic use of students to provide technical support has proven to be critical to the success of the project. The results of this past summer's telecommunity training have been spontaneous online mentoring, resource sharing, and content access from Miami University.

Telecommunity has also permitted dramatic advances in preservice teacher development. University and preservice teachers now have telecommunity support which has changed the structure of university mentoring during student teaching and dramatically extended the learning community available to preservice teachers. For example, in the computer module of EDT 343, Media and Technology for Teaching, all students are required to use web conferencing to ask *SchoolNet* teachers about teaching strategies related to using technology, thus allowing students access to resources which otherwise would be unavailable to them.

Moreover, web-based resources play a key role in helping preservice teachers to learn and *teach with* education technology. For example, the computer module's syllabus is only available via the web and links students to other relevant web-based activities and materials. In addition, since time is a critical factor, students access instructional materials on writing objectives and then practice identifying examples and non-examples of well-written instructional objectives. Using FlexMail, results of students' performance are sent to the instructor and students receive immediate online feedback about their performances. All course materials are also contained on the EDT 343 computer module's web site and portable document files are used extensively which allow students to access a wide range of instructional materials. As students become more socialized to accessing web-based materials, it is the instructor's goal to transform the curriculum into a paperless one.

Students must also plan, develop, and team teach a 90 minute, multidisciplinary problem- or project-based lesson which uses technology to support their identified learning outcomes. As part of this teaching project, students must demonstrate evidence of using web-based resources for their own professional development, identify related Ohio state proficiency outcomes on Ohio Department of Education's web site, and integrate web-based resources into their lessons. To aid in these assigned tasks and provide lesson planning structure, students are required to use a web-based lesson plan construction site (*WebPlan*) which is based on the *LessonLab* model, to create, store, and edit their lesson plans online. In addition, *WebPlan* provides students with a technology integration model and a link to the *Apple Learning Interchange* should they need ideas for lesson planning or teaching with technology. When finished peer teaching, student teams are also required to digitize video clips of their teaching which are then published to the web as part of their professional portfolio.

Whenever possible, student teachers are placed in technology-rich *SchoolNet* classrooms with the objective of further developing their ability to integrate technology into curriculum and instruction, skills which were introduced to them in the computer module of EDT 343. Using *SchoolNet* resources and Talawanda's FirstClass Intranet Server, telecommunities have developed between university supervisors, mentor teachers, and student teachers to enhance communications between all parties and advance student teachers' learning experiences and opportunities. Student teachers and their supervisors are also given regular opportunities to develop their teaching with technology skills on a per-request basis and to develop a web presence by learning html and web

site design skills. As a result, students have learned new technologies like HyperStudio and developed personal home pages, online professional portfolios, and web pages to support the respective classes they teach.

Conclusion

Using the TEAM model, the *Partners In Learning/SchoolNet Prototype* in the Talawanda City Schools, Tri-Village Local Schools, and Miami University is positioned to advance and offer developmental insight on teacher and administrator network, telecommunity, and curriculum development as well as education technology adoption at both the pre- and inservice levels. Outcomes to date suggest that web- and Intranet-based telecommunities, properly installed and professionally developed, can: (1) have a transformative impact on the culture of teaching and learning; (2) be effectively used to provide and host a rich array of curriculum and publishing opportunities; and (3) serve as a critical component of a K-16 approach to the adoption of education technology.

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Computer Based Training Centre: Integration of Traditional Teaching Methods and Modern Telematics Based Techniques

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Computer Based Training Centre - centralised and integrated computer based support system for studying, teaching and administrating with special support for distance learning and teaching.

Introduction

There is an urgent need for increasing the graduate output of embedded software engineering. A large amount of retraining and on-the-job training is needed, thus, demanding more flexibility in teaching arrangements. Computer Based and Telematic Learning (CBTL) is the most relevant use of technology in Northern-Finland, where distances are great, but the telecommunication infrastructure is well developed. In order to meet the ever-increasing need of the electronics industry for engineering professionals, Computer Based Learning Centres are being established for ensuring the required number of university and polytechnic graduates in this field.

In the "Institutes of Higher Education" pilot of the IDEALS project (in the EU TELEMATICS programme), the Raahe Laboratory of Oulu University (hereafter referred as RATOL) has created a 16-hour Graphical User-Interface Programming course, utilising in-house courseware and material obtained from the other two universities in the pilot [Ideals 95]. The IDEALS project is currently in its demonstration phase and the final results will be put together in June 1998.

Based on the experiences from the IDEALS project, and especially from the IDEALS-MTS (Modular Training System), RATOL has been continuing research and development work with a new follow-up project, which aims to the introduction and utilisation of the Computer Based Learning Centre. The methods and methodologies developed within IDEALS will be utilised and customised for current needs in RATOL.

Objectives

With the introduction of the Computer Based Training Centre (CBTC) RATOL aims at improving the current engineering education situation in the areas of information sharing, learning and teaching quality, as well as, the overall graduate output [Paaso and Manninen 97]. The CBTC project will provide the required knowledge and technology for the implementation of large-scale learning and teaching support system.

The main goal of the CBTC project is to survey the needs and requirements of the system's three end-user groups - students, teachers, and administrative people. Based on the survey, the requirement specification for the full-scale integrated system will be created. The prototype of the system will be used to demonstrate the capabilities of the techniques, and the functionality in practice. In addition to the technical aspects, the methods and methodologies for distance education and collaborative studying and teaching will be researched and analysed. New solutions will, whenever applicable, be introduced during the utilisation phase of the project.

Computer Based Training Centre

The starting point for the development of the Computer Based Training Centre is the current situation in the Raahe Laboratory of Oulu University. The amount of distance learners has been increasing, and the electronics industry is demanding more engineering professionals to fill the ever-increasing need for educated employees. Good career

opportunities draw students towards the industry, thus, resulting in more requests for distance learning study programs.

The Computer Based Training Centre will be developed to enable and enhance the smooth flow of information between the teachers, students and administrative people. The main problem with the current situation in RATOL is the scattered and decentralised sources of information - the student is forced to collect the needed facts from several places. This usually requires a physical visit to the source of information, thus preventing effective distance learning possibilities.

The Computer Based Training Centre interacts directly with the three end-user groups: students, teachers, and administrative people. Furthermore, the effective area of the Centre reaches from the other branches of Oulu University all the way to the European-wide Local Training Centres. Figure 1 represents the main end-user groups of the Centre.

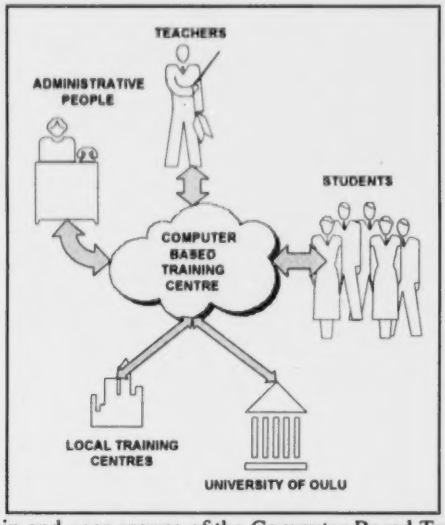

Figure 1. The main end-user groups of the Computer Based Training Centre.

The technical solutions of the CBTC will rely on known standards and applications with the Internet and World Wide Web being the main transfer media. End-users using WWW browsers and integrated plug-ins as user-interface have all the necessary system resources within their reach. The services available from the system are divided into three categories based on the required bandwidth of data transfer. Table 1 illustrates the different service categories and the minimum speed requirements for them.

Table 1. The three service categories of the Computer Based Training Centre.

Category	Minimum Speed	Available Services
Class 1, MOBILE	9,6 kb/s	Text/HTML/SMS/email
Class 2, MODEM	28,8 kb/s	+ Binary data/images/audio
Class 3, ISDN+	64 kb/s	+ Video and video conferencing

The services of the CBTC include a course material library, Computer Based Training courses, communication forums, bulletin boards, real-time chat areas (text, audio and audio/video), personal and group workplaces (virtual desktops and laboratories), and various templates and guidelines to enhance the learning process and quality. The main information administrator of the system is one full-time office employee. Each end-user group has some responsibilities and activities of information storing and updating (e.g. lecturers manage their lecture notes) [Giordano 97].

In addition to the basic services, the Centre will provide the students with proper tools to support the actual learning process. The problem, especially with the distance students, is the lack of a continuous learning process, which in turn leads to the termination of the studies. In order to keep the learner active, there are various project management tools and metrics, which can be used to plan, monitor and report the progress of the studies.

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The basic infrastructure of the CBTC consists of the network (LAN, WAN, Internet), the servers, and the client workstations. The connection types and workstation model varies depending on the user. The servers can either be located on the same physical machine, or they may be distributed transparently among several computers. Figure 2 illustrates the basic infrastructure.

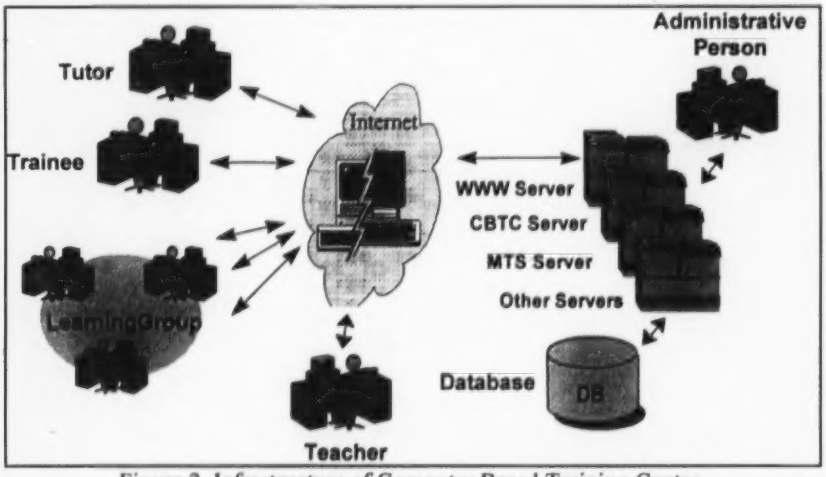

Figure 2. Infrastructure of Computer Based Training Centre.

The scenarios included in the pilot Computer Based Training Centre are as follows:

- Fully computerised CBT material and course (based on the results of IDEALS project) [Paaso et al.]
- CBT course material of Computer Engineering produced by European-wide collaboration (co-operation with the European Association for Education in Electrical and Information Engineering)
- Course material library which introduces all current course material types and formats
- Real-time communication within the virtual class room / seminar room / laboratory
- Remote access and control of the testers within the development of embedded systems (co-operation with the Raahe Institute of Computer Engineering)
- Remote execution of Computer Engineering laboratory project (co-operation with the Electrical Engineering Department of Oulu University)

The full-scale utilisation of CBTC requires extensive structural changes in the entire educational system. Even in its most concise form, the exploitation of the Centre needs modern supporting methods together with several compromises between the current system and the new computer based system. One of the solutions planned, is the integration of intensive lecturing periods to the otherwise emphasised distance learning. For example, the idea is to provide the students with three or four periods (two weeks each) of traditional lecturing and laboratory exercises during the academic year. Other teaching and training activities would be managed through the Centre. One of the main goals of the project is to create preconditions for the introduction of the Computer Based Training Centre, first in the Raahe Laboratory and then in other branches of Oulu University.

The pilot study phase of the project was launched in December 1997 and the first prototype of the system will be demonstrated in September of 1998. After the six month demonstration and development period, the system will be evaluated by every end-user group. Based on the results of the evaluation, the system will be utilised with the aid of a pre-planned utilisation plan.

Conclusions

The final research results will be collected and analysed in August and September 1998. So far, the research work has been targeted to survey the existing solutions and the requirements of the end-users. Preliminary reports have been written and the user requirement specification of the system is in its final processing phase.

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The main problem encountered so far is not the limitations of technology but the attitudes of the people and the current working culture. A major effort is required in order to utilise the aforementioned system in everyday teaching scenarios.

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PSL: An Alternate Approach to Style Sheets for the Web

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Abstract: Style sheets, which are used to specify the appearance of Web documents, are rapidly growing in their importance for the World Wide Web. Cascading Style Sheets are now in widespread use and initial work on a future Web standard, the Extensible Style Language (XSL), is proceeding at a rapid pace. In this paper, we show how a different style sheet language, PSL, represents an attractive midpoint between CSS and XSL in complexity and power. PSL is based on general language design principles that give it simple syntax, easily-described semantics, and considerable expressive power. PSL is supported by Proteus, a portable style sheet system that allows the construction of novel user interfaces for Web browsers and other presentation tools through support for multiple simultaneous presentations of the same document.

1. Introduction

Style sheets are used to specify how a document should be presented to users. For Web documents, style sheets can be used to specify fonts, colors, borders, and overall layout, as well as other style properties. For example, a style sheet might indicate that the document's title should appear centered on the top of the first page in a 36 point Helvetica font.

Style sheets can be used for a variety of purposes:

- They can enforce consistent style across a large collection of similar documents;
- They can describe style effects that go beyond the style information implicit in a document's tag structure; and
- They provide the ability to tailor a document's presentation to the needs of the end user or the capabilities of the presentation device.

In the Web community, the usefulness of style sheets for HTML [Raggett 97] documents has become apparent because style sheets give document designers a level of control over the appearance of their documents that HTML alone cannot provide. Several style sheet languages are being developed including Cascading Style Sheets [Lie et al. 96, Bray et al. 97] and the Extensible Style Language [Adler et al. 97].

This paper describes our study of style sheet languages for HTML documents. We believe that in an ideal world, a style sheet language would have

- simple syntax so that the language is easy to read and write
- consistent and easily-described semantics so that style sheets are easy to understand and straightforward to explain to others; and
- the ability to specify a wide variety of useful presentations.

We are interested in finding the best way to balance these sometimes-conflicting design goals for style sheet languages.

Our research has focused on the application of an alternate style sheet language, the Presentation Specification Language (PSL) [Munson 96] to HTML documents. We have developed an experimental Web browser, MPMosaic [Marden et al. 98], that uses PSL style sheets to control the appearance of HTML documents. Our work with PSL shows that it is possible to create a style sheet language that is at an attractive midpoint in both complexity and expressive power by basing the language on very general design principles in conjunction with simple syntax and semantics.

The remainder of the paper is organized as the following. Section 2 describes some other style sheet languages. Section 3 provides an introduction to PSL. Section 4 discusses the advantages of PSL's use of general language facilities in comparison to Cascading Style Sheets. Section 5 describes our experiences in using PSL in the MPMosaic system and the final section presents our conclusions.

2. CSS, XSL, and DSSSL

Style sheets have been used for some time in the structured document community, where a central premise has been that the appearance of documents should be specified separately from their structure and content.

SGML and DSSSL are the respective ISO standards for structure and presentation. SGML [ISO8879 86] is a meta-language for defining markup languages, like HTML, that are used to describe the structure and content of individual documents. The elements (or tags) of each SGML-based markup language is specified by a Document Type Definition (DTD) written in this meta-language. DSSSL [ISO/IEC10679 96], SGML's companion standard for style sheets, is a powerful, Turing-complete style language based on the Scheme programming language.

DSSSL is a very complex language both syntactically and semantically and has not yet seen widespread implementation or use. DSSSL is clearly very powerful, but the lack of working implementations makes comparison difficult. DSSSL could be used to describe HTML documents, but has usability problems for interactive systems that has prevented its inclusion in any widely-used editing or browsing software.

The World Wide Web Consortium (W3C) has developed a language called Cascading Style Sheets (CSS) which has become the standard style sheet language for the Web. CSS Level 1 (CSS1) [Lie et al. 96], the first version of CSS, is now partially supported by the major browser vendors and a more extensive version, CSS Level 2 (CSS2) [Bos et al. 98], has recently been developed. Work has also begun on another proposed style sheet standard, the Extensible Style Language (XSL) [Adler et al. 97], which is derived from DSSSL and appears to support most of DSSSL's features.

CSS is at the other end of the design spectrum from DSSSL and XSL. CSS has a very simple syntax, but limited expressive power. CSS has been explicitly designed to be written by non-programmers and often provides nice, intuitive ways to express style ideas. However, this intuitiveness comes at a the cost of consistency. The semantics of CSS are not consistent across language features, and we believe the language will grow increasingly difficult to reason about as new features are added to it.

Due to length restrictions, we will not describe the features of the CSS, XSL, and DSSSL languages in any detail. We urge readers to review the specifications for CSS1 [Lie et al. 96] and CSS2 [Bos et al. 98], if they are not familiar with them. For general information on style sheets, the Web Consortium has a number of resources at http://www.w3.org/style.

3. The PSL Language

PSL is the style sheet language for Proteus [Graham et al. 92], a portable presentation system for multimedia documents. PSL is a declarative language that was designed to be independent of any particular medium. PSL's syntax and semantics were designed to be easy to use, and the language has very few special cases. An example style sheet is shown in [Figure 1].

In order to understand how PSL (or any style sheet language for HTML) works, an important fact about the structure of HTML documents must be understood. Structured markup languages like HTML annotate the document contents with tags, or markup. The tags break up the document into elements such as paragraphs, lists, headings, and emphasized text. Because elements can be nested inside other elements, they can be thought of as the nodes of a tree that represents the entire document, which we call the *document tree*. All existing style sheet languages take advantage of this tree structure.

PSL provides three presentation services: property annotation, tree elaboration, and box layout. In Proteus, these services operate on a *presentation tree*, which is a copy of the document tree. Using a presentation tree allows multiple styles of the same document to be shown simultaneously.

- Property annotation assigns values to the formatting properties of each element, or node. Section 3.1 describes the syntax for assigning values to properties.
- Tree elaboration allows style sheet authors to add content to the presentation by adding elements to the presentation tree (section 3.3).
- Box layout is a constraint-based layout system that works well with both textual and non-textual media. We will not examine PSL's layout services in this paper in any depth.

3.1 Properties and Rules

In the `RULES` section of the style sheet, the presentation of an element can be specified by following the element's markup name (also referred to as node name) with a list of property rules:

```
P {
    fontFamily = "times";
    fontSize = 14;
    lineHeight = Self.fontSize * 1.5;
    indent = LeftSib.indent + 10;
}
```

This specifies several properties for P elements: the font for text should be 14 point Times, the line height should be 21 points (1.5 times the font size of this element), and the first line of text should be indented 10 points more than this element's left sibling. Property rules have the form:

<property> = <expression>;

The right hand side of the property rule can contain any expression whose data type is the same as the type of the property named on the left hand side. Expressions can be constructed using a variety of operations and functions common to general-purpose programming languages including standard arithmetic, comparison, and boolean operators, common mathematical functions (such as min, max, and round) and trigonometric functions.

Property values can be constrained to depend on the property values of other nodes (elements) by using the property access expression, for which the syntax is:

<node expression>.<property name>

A property access expression's value is computed by finding the node specified by the expression on the left hand side of the dot and getting the value of the named property for that node.

There are several tree traversal functions that return nodes, any of which can appear on the left hand side of a property access expression. Some of these functions return immediate neighbors (`Parent`, `LeftSib`, `RightSib`, `FirstChild`, `LastChild`, and `NthChild`), while others return nodes that may be more distant (`Root`, `AncestorOfType` for obtaining ancestors, and `Creator` which returns the generating node of an elaborated node). There is also a `Self` function which returns the defining node, the node for which the property rule was defined. Collectively, these functions are designed to allow the specification of constraints between the defining node and every other node in the tree. Distant nodes in the tree can be specified through function composition, as in `FirstChild(LeftSib(Parent)).fontSize` which specifies the fontSize property of a "cousin" node.

3.1.1 Default Rules.

PSL style sheets can have a `DEFAULT` section which defines default rules that are used when there are no node specific rules for a property. The `DEFAULT` section contains a rule list having the same syntax and semantics as the rule lists for specific node types.

```
MEDIUM mosaic;
PRESENTATION links FOR html;
ELABORATIONS {
      linebreak : Markup ("<BR>")    {
            visible = Yes;           }
      arrow : Markup ("<IMG src=arrow-grey.gif>") {
            visible = Yes; }
      url : Content (getAttribute(creator, "href")) {
            visible = Yes;
            fontSize = 12; }
}
DEFAULT {
      lineHeight = Self.fontSize * 1.5;
}
RULES {
      HTML {
            visible = No;
            fgColor = "black";
            fontSize = 14;
      }
      A {
            if ( getAttribute(self, "href") != "" ) then
                  visible = Yes;
                  fgColor = "blue";
                  underlineNumber = 1;
                  CreateRight (arrow, url, linebreak);
            endif
      }
}
```

Figure 1: A style sheet written in PSL. This style sheet specifies that only links and their destinations should be displayed on the screen.

```
<HTML>
   <TITLE> A Sample Document </TITLE>
   <BODY>
      <H1>
         <A href="http://w3.org"> Style sheets </A>
      </H1>
      <UL>
         <LI> Give the <B> user </B> control of formatting
         <LI> Support multiple presentations
      </UL>
   </BODY>
</HTML>
```

Figure 2: A sample HTML document.

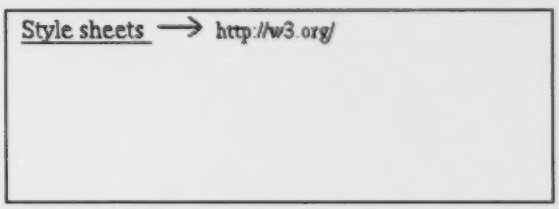

Figure 3: This is the presentation of the HTML document in [Figure 2] that is generated by the style

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3.2 Order of Evaluation

Every property in every node is assigned a value. The value of a property is determined by the first source below that returns a valid value for that property:

1. Node specific rule.
2. `DEFAULT` section rule.
3. Inherited value
4. Medium specified value. (CSS calls this the initial value.)

Invalid values occur when a rule fails, namely its expression cannot be computed for some reason. This could occur because of an arithmetic error (such as division by zero), but most commonly it results from a tree navigation error. For instance, a node that is a first child has no left sibling, so if the `LeftSib` function is invoked on a first child, the function fails.

All properties can be inherited. This is equivalent to a rule of the form:

<property> = Parent.<property>;

3.3 Tree Elaboration

Tree elaboration allows style sheet authors to add content to a document's presentation by adding nodes to the presentation tree. For example, tree elaboration is used to precede list items with numbers or "bullets," and is used to create borders around elements.

Tree elaboration is specified in two parts: node declarations and creation commands. The node types that can be generated are declared in the `ELABORATIONS` section of the style sheet. Theses declarations specify a primitive type: Content for text, Markup for tags, and Graphic for graphical objects like lines, rectangles, and circles. Declarations also require an initialization argument, which is an expression that describes the content of the generated node. Properties of generated nodes are treated in the exactly the same manner as are properties of other nodes.

In the style sheet in [Figure 1], there are three node types declared in the `ELABORATIONS` section. The first declaration defines a node type called `linebreak`, which can be used to add `<BR>` tags into a document to force linebreaks. The next declaration creates an `arrow` node type that can be used to insert an image of an arrow into the presentation. The third declaration allows the style sheet author to display the target of a link (the href attribute of the A tag).

The actual generation of nodes is controlled by the creation commands: `CreateLeft`, `CreateRight`, `CreateFirst`, and `CreateLast`. These commands create and attach nodes to the defining node. As the names suggest, the functions attach the nodes as left siblings, right siblings, first children, and last children, respectively, while maintaining the ordering specified in the argument list. In the style sheet in [Figure 1], every `A` node will have `arrow`, `url`, and `linebreak` nodes created as right siblings as the result of the node specific rule:

```
CreateRight (arrow, url, linebreak);
```

3.4 Other Features

PSL contains a number of other language features. PSL's grammar contains an if-then-else conditional construct that is very useful for making rules dependent the results of arbitrary expressions. PSL supports the addition of function-like commands (referred to as interface functions). For HTML, we added the functions `getAttribute` for obtaining an element's attribute, `getMarkup` for obtaining the markup string used in the document, `getText` to return the text of a node, and `windowHeight` and `windowWidth` for getting the height and width of the browser's window.

In addition to the standard flow model, PSL's box layout system can be used to specify constraints between elements of the document. It is possible to define constraints that place document elements on the screen in an order different from their order in the HTML source. This approach eliminates the need to support a general tree transformation system, like those in DSSSL or XSL.

4. Comparing PSL and CSS

In this section, we compare some of the features of CSS and PSL. Our standards for comparing the two languages are based on the standards put forth in the introduction which stated that a style sheet language should have

- simple syntax;
- consistent and easily-described semantics; and
- the ability to specify a wide variety of useful presentations.

4.1 Syntactic Complexity

Both CSS and PSL have simple syntax, but CSS is still noticeably simpler than PSL.

- Where PSL style sheets have a number of different sections (e.g. DEFAULT, RULES, ELABORATIONS), CSS essentially has only one section that is equivalent to the RULES section of PSL.
- Because PSL allows the right-hand side of property rules to be general expressions, it has a standard set of syntactic rules for expressions. In contrast, the right-hand side of CSS property rules are simply constant values (generally strings, keywords, or numbers).
- PSL has a conditional rule syntax for which CSS has no equivalent.
- CSS supports a variety of contextual selectors that are used to specify rules that apply to elements only when they appear in certain contexts. The syntax for specifying contextual selectors is simple. In PSL, similar ideas can only be expressed using conditional rules.

Overall, CSS has somewhat simpler syntax than PSL, though the difference is not dramatic, especially when compared to languages like XSL and DSSSL.

4.2 Semantic Consistency

A more striking contrast between PSL and CSS can be found in the area of semantics. PSL has simple and consistent semantics that are applied uniformly throughout the language. For example, property rules have the form:

<property> = <expression>;

The right-hand side of these rules may be any expression whose type matches the type of the property. The restriction that the types match is the only restriction. Since PSL provides a wide range of expression operators, it is possible to specify almost any desired effect, but some effects may require complex expressions. In contrast, CSS is designed to allow convenient specification of common presentation effects and does so at the price of consistency. CSS property rules are written

<property> : <value>;

Most CSS properties define a mixture of keywords, numbers, and length measurements, and these values are predetermined to be absolute values or relative to another property value.

As an example, here are four different rules for the CSS font-size property:

```
P { font-size: 12pt; }
P { font-size: medium; }
BLOCKQUOTE { font-size: larger; }
EM { font-size: 200%; }
```

The first rule uses a length which is an absolute value. The second rule uses an absolute-size keyword which gets a value from a table of size preferences maintained by the browser. The third rule uses a relative-size keyword that specifies a size relative to the parent. The fourth rule uses a percentage which is also relative to the parent's size.

Nearly every CSS property has different rules for the values on its right-hand side, and it is not much of an exaggeration to say that each property's right-hand side has its own specialized language. This point is illustrated by the line-height property. It does not accept the keywords that can be used with font-size and, in addition, percentages are interpreted relative to the font-size of the current element, rather than relative to the parent element's line-height. For example, this rule

```
EM { line-height: 200%; }
```

specifies that the line height for EM elements should be twice as large as its font size. This is a natural way to specify line-height, but it is not consistent with the treatment of percentages in other parts of the language.

In a small language like CSS1, some inconsistency in semantics is easily tolerated. However, as a language's scope is increased, as is being done with CSS2, it becomes progressively harder to describe the language and to understand it. So, even though the semantics for each property are generally intuitive, we believe that as properties are added to CSS, its users could become overwhelmed by special cases and will be forced to depend on manuals as they write style sheets.

PSL's consistent semantic design allows it to be well described by a small set of rules that are independent of the set of properties used by a particular application. It is certainly the case that as new properties are added, they will have to be described and will make descriptions of the language more complex. However, any additional complexity is only the result of a more complex style model, not the result of greater complexity of the specification system.

4.3 Expressive Power

PSL has more expressive power than CSS because it provides general mechanisms to describe effects. CSS tries to provide similar power through a wide variety of special cases. However, the range of special cases available is limited to those cases that CSS's designers have recognized as valuable. The problem is not that CSS's designers are not perceptive and thoughtful, but that it is simply not possible for any language designer to anticipate every interesting and useful presentation effect. Suppose that a document designer would like to emphasize text by making it 20% larger than the text that precedes it. In PSL, this style is easily specified with one rule:

```
EM { fontSize = LeftSib.fontSize * 1.2; }
```

In general, CSS cannot specify this style because, for the font-size property, relative values are always relative to the parent. (Extensive use of contextual selectors might be sufficient to handle this case, but would require enumerating every possible context that EM elements could appear in.)

5. Experiences with MPMosaic

Our experiences with PSL have been very positive. Our testbed is Multiple Presentation Mosaic (MPMosaic) [Marden et al. 98], a modified version of NCSA's Mosaic browser. In MPMosaic, users can select their own style sheets to control the appearance of a document regardless of the document's origin

or authorship. MPMosaic also supports multiple presentations --- users can open multiple windows displaying the same document with each window using a different style sheet.

We wrote PSL style sheets that provide "views" of HTML documents. These views can be as used as visualization tools to help users understand documents. Our browser can display a view side by side with the standard HTML presentation. Below are several of the views created with PSL style sheets.

- *Table of contents view.* Shows only the headings (the H1 through H6 elements).
- *Tree-structured view.* This presentation shows the tree structure of a document. The markup tags of elements are shown and each is indented further than its parent's tag.
- *Links view.* Only anchors and their destinations are shown.
- *Embedded tags view.* The markup tags are displayed in the formatted document.
- *Reduced size view.* All fonts and images are shown at half size.

[Figure 3] shows the links view of the document in [Figure 2]. The links view is generated from the style sheet in [Figure 1]. The links view can be used as a inter-document navigation tool since it shows all the possible destinations the user can reach from the current document.

Support for PSL was added to Mosaic by using the Proteus style sheet system. Mosaic's formatter was not significantly altered when we added the Proteus library to Mosaic to make MPMosaic. Approximately 600 lines of C++ code were added to the 8000 line formatter in Mosaic.

6. Conclusions

Many people in the document community have believed that in order for a style sheet language to have powerful formatting capabilities, the language must approach the complexity of a programming language and that style sheet languages with simple syntax will be special purpose languages with limited capabilities. Our experience with PSL has shown that there is a middle ground: a style sheet can have simple syntax and semantics while having considerable expressive power. PSL's power is the result a design based around general principles with an emphasis on simple and consistent language constructs.

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Introducing PHOENIX: the Rebirth of the European Museum Network for the Web

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Abstract: The PHOENIX system aims to recover the contents generated within the European Museum Network (EMN) Project by means of making its multimedia assets accessible via WWW. In order to achieve this, we have focussed on the Visitors System, by developing a software module whose goal is the presentation of the hypermedia i n-formation of the EMN Multimedia Database System (MDBS). The EMN Information System has been analysed and the WWW PHOENIX Visitor application has been d e-signed within a generic Information System Model, currently working at (http://www.gti.ssr.upm.es/phoenix).

1. Introduction

The European Museums Network Project (EMN, RACE-1078) [Visser, 1993] was one of the application pilot-projects within the RACE programme of the European Union. The aim of this project was to provide and develop the exchange of multimedia information through advanced telecommunication technologies. Information on museums' objects was available primarily for the museum's lay public. The museums' visitor could access the EMN through interactive multimedia terminals in one of the eight participating museums. The European Museums Network project was developed between the years 1989 and 1992 under the line of I+D promoted by the EU for the application of new technologies (hypermedia in this case) to the cultural world.
Besides the technical system (applications and the object oriented Multimedia Database System -MDBS-) developed within the EMN project, the main results where the multimedia assets created by the museums' curators. The exploitation of the system was abandoned in 1994.
The first objective of the PHOENIX project, described in this paper, is the reuse of the contents generated within the EMN Project by means of making the Multimedia assets accessible via WWW. In order to achieve this, we focus on the Visitors System and develop a software module whose aim is the presentation (read only access) of the hypermedia information of the EMN MDBS via WWW.
The further development of a module for the creation, maintenance and update of the database (Administrators System) depends on the results and impact of the PHOENIX Visitor System.
The paper is structured as follows: section 2 introduces the EMN Information System, section 3 presents two models for locating the developments to be carried out, while section 4 summarises the design of the PHOENIX Visitor application (on-line access is available at http://www.gti.ssr.upm.es/phoenix) in relation to the previously presented models. Section 5 concludes the paper and presents future work, already going on.

2. The EMN Multimedia Information System

2.1. General Description of the System

The central system, where the database is located, offers the centralisation and versions management services requested from the local systems, connected with the former through communications networks. These local systems are replicated servers that belong to the museums and are updated through the central system. Users access the local servers through LANs.

Visitors access the version of the database in the local system; administrators are capable to contact through the LAN with the local system and with the central system through communications networks.
The EMN software system consists of three different programs that have access, in different degrees, to a common pool of data physically stored in each museum (local system) and in the central system databases:

- **Visitor System**, for the presentation of the museums' assets, with read-only capabilities of the data pool of objects of the museums, previously introduced by the curators using the MDA systems.
- **Local MDA** (*Multimedia Data Acquisition*) **System**, for the addition of new data and modification of the data of each museum. This program can create updates to send to the Central System and can incorporate upgrades received from it.
- **Central MDA System**, for the central management of the data pool. It receives updates from the museums and produces upgrades of the data pool to be sent to the museums.

2.2. The Multimedia Data Base System

These are the main characteristics of the developed MDBS [Martínez, 1993]:

- Design based on an object-oriented architecture.
- Client/Server Model. The server module offers the management of the database functions and access to the permanent data. The client module offers the interface on which the user application program is built.
- It is independent of the application it has been designed for. The same MDBS can be used for completely different databases and for different applications.

2.3. Design of the EMN Applications

The application programs work and the data types are designed upon the aforementioned MDBS. The application design is divided in three phases: content design, application behaviour development, and user interface development.
The Data Base Server handles the data pool and the data creation process. It comprises the MDBS and the EMN API, which provides the EMN application behaviour to be presented by the GUI.

2.3.1. Content design

The GIP (*General Information Pool*) is the root object: it acts as a directory of the information stored in the database. The GIP, apart from information for the administration, contains two lists:

- Objects: the main information type in the database;
- ASTs (*Assisted Tours*): guided tours through a set of objects.

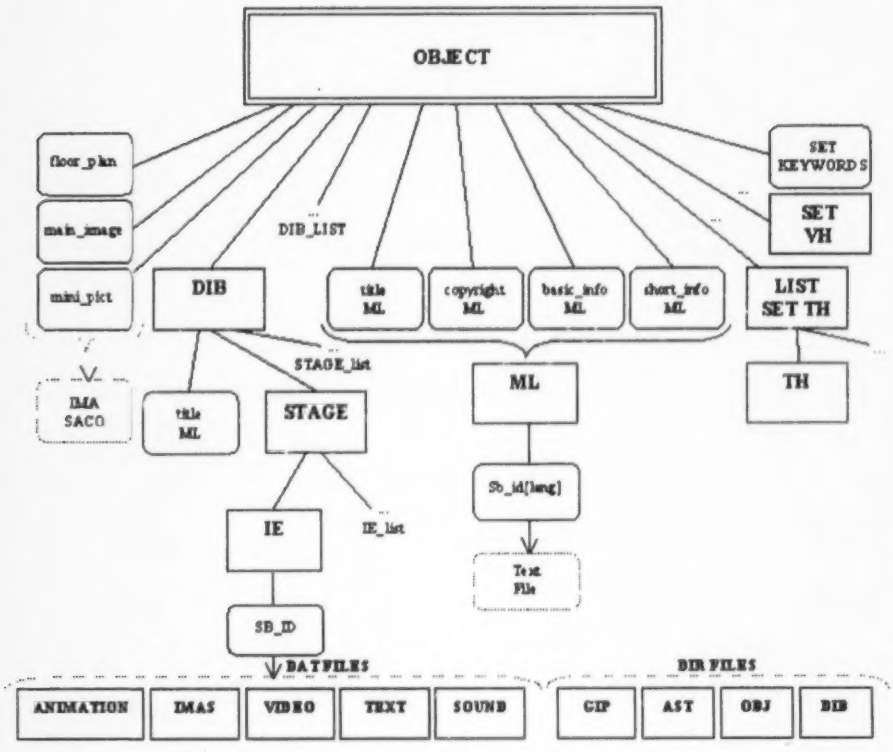
Each object includes a set of contents (see Figure 1):

- a title, basic information and detailed information;
- a main image, a mini-image and a floorplan;
- a list of additional information (material, author, ...);
- a set of keywords;
- a set of DIBs (*Detailed Information Bit*), which include a title and a set stages containing information elements (IE), that can be images, texts or sounds;
- a set of visual hot areas of direct access;
- a set of textual hot areas of direct access;
- permissions for different access levels.

Each AST contains a list of object (and optionally DIBs) identifiers, which are created by the curators in order to provide a guided tour on some topic.

2.3.2. Application behaviour and GUI development

The user interface is in charge of the presentation and the direct dialogue with the final user, and could handle directly the functions given by the client module of the database. Instead of this, an application-programming



interface (API) was developed into the EMN project in order to make easier the access to the objects by the user interface.

Figure 1: Schema of the Object Components

In this way, the user interface only takes charge of the presentation and the acquisition of data that are later handled by the application interface. The user interface does not need to know anything about the inner structure of the database, it only knows how many types of information there are, what their contents are and how to present them. This approach allows to separate presentation and interaction design from application behaviour design.

3. General Models

Here we present two complementary models that allow us to identify the different modules within our development. Further details about the models can be found in the references.

3.1. Information System Model

One of the main components of any Information System is the Information Server, which provides information on demand to remote users via clients or browsers (when we concentrate in Information Retrieval Systems, as is the current case). We can further concentrate its operation into three elements (see Figure 2):

- Communications Server, which manages communications with the client.
- Service Engine, which provides accounting, security, ... services.
- Information Engine, responsible for handling the information flow.

Due to the objective of this project, we will work with a HTTP server to allow the access from the Web. This server will provide the functionalities of Communication Server and Service Engine, so we will focus here on the Information Engine.

The main task of the Information Engine [Martínez, 1996a] is the management of the information flow driven either from the user to the storage systems (via queries), or from these to the end user (via results). It is responsible for translating each data structure and content of a storage system to a common data representation providing a structure-independent access. Besides it can provide session management, access control and information filtering.
This engine also shows two well-defined interfaces:

- Information Services API, interface to the application developer: set of services to develop applications.
- Storage and Retrieval API, interface to the storage systems: set of functions that each gateway to a connected database should fulfil.

Information Services cover functionalities dealing with session maintenance, navigation and searching, retrieval, storage and customisation.
Besides, the storage and retrieval API acts as a gateway to different storage systems, providing a database abstraction to the information engine.

3.2. Hyperbase Model

A hyperbase is a system that extracts information from a database to generate hypermedia. In this case of the WWW hyperbases exist thanks to CGI among other methods, such as *servlets* and server's proprietary APIs. An hyperbase consists of an information server (e.g. HTTP server) and a gateway between that server and the database from where the information is taken. An hyperbase can be seen as a particular case of the information server model seen.
A storage system gateway [Martínez, 1996] provides the information to the corresponding information server. In this project, the information server is an HTTP server that serves information to the different clients or browsers, while the storage system is the database developed in the EMN project.
From a software point of view we can distinguish three levels [Martínez, 1996] with different functions inside a gateway:

- Gateway Interface: provides the services that use the functionality of the gateway core. The interaction with the user takes place at this level.
- Functional Core: provides generic functionalities like session support, document composition, data localisation, information filtering, etc.
- Database Interface: provides the access to the storage system by the functional core. It is closely related to the database.

Figure 2: Comparative between Models: Information Engine-Gateway

4. Design of the PHOENIX WWW Visitor Application

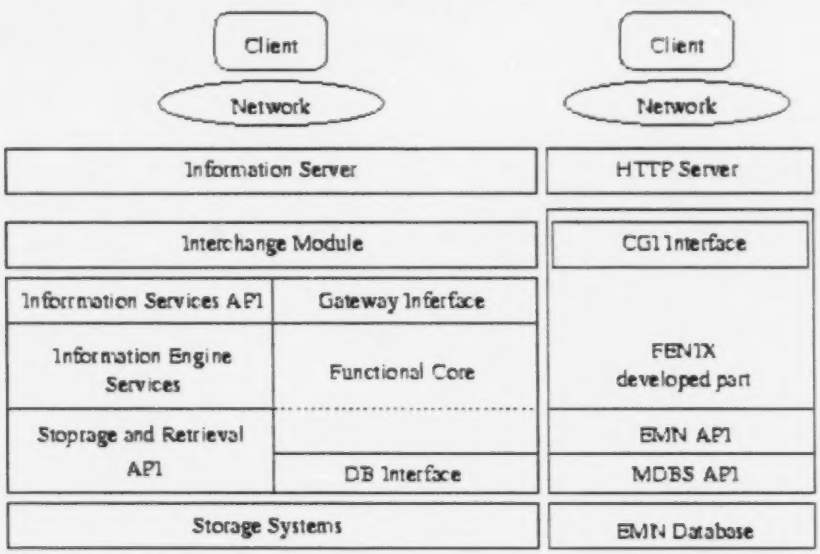
A Hyperbase can be seen as a particular case of an Information Server. The Information Server (HTTP server) corresponds to both the Services Engine and the Communications Server, while the Gateway corresponds to the Information Engine, as Figure 2 depicts.

The main difference between both the Gateway and the Information Engine Models previously seen has to do with the interface to the storage systems. The Storage and Retrieval API (Information Engine) includes data and structure (it provides an abstraction to the engine), while the DataBase API (Gateway) has a lower level "closer" to the database (see Figure 2).
The information engine and the gateway provide their information services through an API (considered as a functions library) that can be directly used by the information server (linking the server code extended functionalities with the API provided services). Another option to provide these services is the development of an Interchange Module, which allows the server to invoke external programs instead of recompiling the server. In PHOENIX, the Interchange Module is implemented by means of the CGI mechanism.

4.1. Functions provided by the EMN API

The functions provided by the EMN API (considered within the scope of an information engine, as a Storage and Retrieval Module) to the gateway are the following:

- State Maintenance: The functions *storage_open* and *storage_close* allow, respectively, to open and close a session to the EMN MBDS.
- Searching Support: The functions of this group correspond to the EMN function *search_keywords*



dealing with the search based on keywords.

- Navigation: The *resolve link* function is related to VHADAs (visual hot area direct access) and THADAs (textual hot area direct access), providing the DIBs the link (hot area) points to.

- Retrieval: The objects' retrieval in the EMN system consists in obtaining the structure of the objects, that contain the structures included in them (DIBs, STAGEs, etc. -see Figure 1-), and afterwards the contents from the monomedia files.

Figure 3: The PHOENIX Visitor application

4.2. Services provided by the PHOENIX Gateway

The services provided by the gateway application to the HTTP server through the CGI are the following:

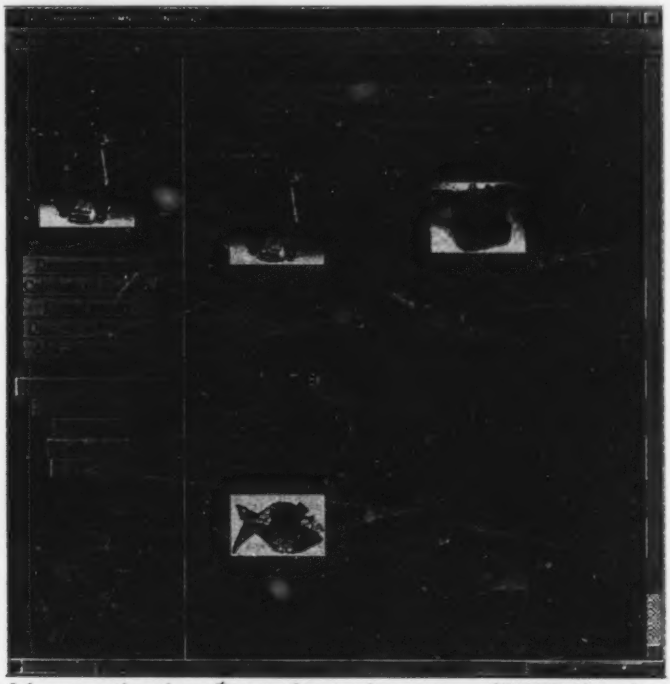
- Session: Both the *open* and the *close* services (of the session in the database) are made automatically by the application when it is necessary. The *history* of the session (state) is maintained by means of two mechanisms; on one hand, the browser maintains in memory the pages visited by the user; on the other, the system is able to hold history information by means of a set of variables. The remainder services of the group are not available in the gateway.
- Searching: For the search we only have the keywords *field*, and the *query form* corresponds to the form to select the keywords. Navigation is performed based on HTML tags interpreted by the browsers.
- Retrieval: *Access* is made by means of the functions to retrieve information elements. The access to the different options within each object is performed via the parameters of the CGI programs.

5. Conclusion and Future Work

The final objective is the reuse of the contents generated within the EMN Project by means of making the whole MDBS accessible via Internet. In order to achieve this, as a first step, we have focused on the Visitors System, and developed a software module whose goal is the presentation (read only access) of the hypermedia information of the EMN MDBS.

The developed application is accessible at the following URL: http://www.gti.ssr.upm.es/phoenix. Currently, only three (DK Nationalmuseum, Copenhagen; Museon, Den Haag; and Museo Arqueológico Nacional, Madrid) of the eight EMN museums have given permission to access their assets.

Future work in the PHOENIX system includes:



- Reduction of the execution time. Due to the stateless nature of HTTP, there is a delay in the operation of the program. At each step of the visit, the gateway has to open a session in the database, recover the

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needed information and close the session. There are two possible ways; to develop a kind of session server, or to change the opening function of the MDBS API to make it faster.

- Some functions of the MDBS API (those having to do with multilingual texts and the recovery of information like images and sound) do not always work properly and should be revised.
- Increment in the number of languages used in the user interface (currently only English and Spanish).
- Development of a software module to implement the edition of hypermedia information within the EMN MDBS. This module should focus on the Administrators System and provide functions to create, maintain, update the local database, and distribute the upgrades to the other museums.

6. References

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Designing a Hybrid Web/CD-ROM Courseware Database and Resource Network for English Learners

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Abstract: The use of multimedia materials such as video clips for education is effective in helping students learn. However, using the Internet sometimes causes students frustration, as it often takes long periods of time to transfer multimedia materials with large file-sizes through the Internet. This paper describes the design and implementation of a hybrid Web/CD-ROM system which we have integrated into to our "Hypermedia ESL Pronunciation Program." The hybrid system is designed to resolve network speed and access problems, and integrate networked information with CD-ROM content to create a seamless learning environment.

1. Introduction

There are a number of advantages to designing and implementing an interactive ESL educational computer network which utilizes the Internet. For instance, students are able to access a great array of educational resources and learning options as compared with ESL-learning programs that do not have on-line access built into their core paradigms. Additionally, teachers are able to reduce system administration and maintenance time, because an on-line system is easily able to track a student's study-history.

However, there are some serious drawbacks inherent to a purely on-line approach to ESL courseware design. The response-time of the system is a crucial consideration. Internet servers, LAN's, and other networks are often incapable of quickly downloading and making accessible high-bandwidth forms of media, such as video clips, MPEG movies and other multimedia materials. As well, simultaneous multi-user access seriously degrades system performance. These problems are significant. Multimedia learning approaches have proven

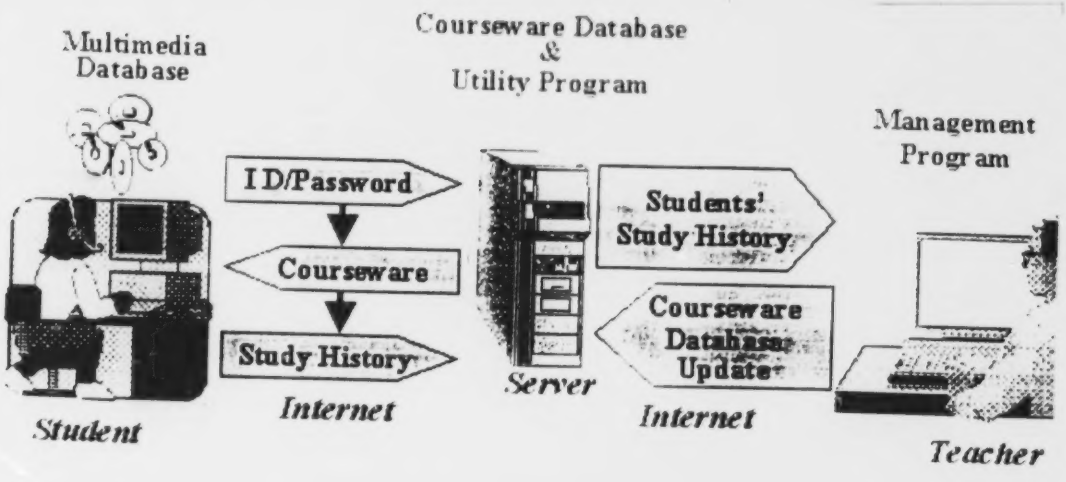

Fig.1 Outline of HWCD-ROM

themselves to be quite powerful ESL educational tools, but are attractive to students only so long as access to the media is simple and 'transparent.'

2. A Conceptual Model of the Web/CD-ROM Network

We can dramatically illustrate this problem by using a real-world example from a hypermedia ESL pronunciation program currently under development, our "Hypermedia Pronunciation Power (HPP)" [McCarthy, Matsuno, and Swan 1997] [Matsuno and Tsutsumi 1998], which is a stand-alone CD-ROM multimedia ESL learning program. Here is an example multimedia file containing AVI movie and sound, which has these specifications: 4.40 seconds in length, with video running at 15 frames-per-second, showing 16-bit colors in a 240 x 180 pixel window, with an 16-bit audio feed sampled at 22.5KHz. This file occupies 988KB, and, at nearly one megabyte in size, presents all the difficulties mentioned above, with regard to system response time and easy user access.

Our hybrid Web/CD-ROM (HWCD-ROM) design is, we feel, a potentially successful systems approach which incorporates all the advantages of the Internet with the advantages of an off-line multimedia database and courseware resource program. Students will be able to easily access complex modes of multimedia information from their desktops, whether they are at school, at home, or at any other remote location. In our hybrid Web/CD-ROM ESL learning system, a number of additional multimedia materials may be added to the existing HPP CD-ROM program, as the database is expanded over time. And beyond the HPP CD-

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ROM itself, further CD-ROM's each containing a diverse selection of multimedia materials, can be added, thus forming a permanent, non-destructible collection.

3. Descriptive outline of HWCD-ROM functioning

HWCD-ROM functioning is divided into three parts:

1. At each student's side we arrange a CD-ROM containing a multimedia database, offering numerous multimedia options, as explained above.

2. On a server computer, we arrange a courseware database, the student's study-history, and several utility programs. When a student logs into the HWCD-ROM program on their local computer and inputs a personal password, that student's personal data is transferred to the server computer. After identifying the user, the server sends back to the student their own study-history and guidelines for their current study-goals. Next, the student chooses an item they want to study, and this information goes back to the server. The server then sends the student the courseware which corresponds to their request. When a student is ready to finish a session, he or she clicks a "Stop" button, and their study-history is sent back to the server computer. Utilizing such a system, teachers will be able to reduce their amount of administration time.

3. For the teacher, the updating and renewal of existing Courseware databases can be accomplished via the Internet, if necessary. Additionally, teachers can extract each student's study-history and test results. Needless to say, teachers and students can also exchange messages, such as questions and answers, via the Internet.

4. Conclusions

We have briefly described the architecture of our hybrid Web/CD-ROM networking system. We can say that by utilizing a hybrid systems-approach to ESL learning via multiple delivery tools and combining the strengths of each network component's utility, we are able to conceptualize an effective ESL multimedia learning courseware database and resource network for English learners. In short, this system seeks to overcome current limitations in technology while providing students and teachers with a powerful and integrated ESL learning program. In the next academic year we will apply the Web/CD-ROM network to the classroom in order to evaluate and improve the system.

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Course Development Environment for Hyperwave

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Abstract: The paper presents a new Courseware Development Environment (CoDE) which is currently being developed for Hyperwave WWW servers.

1. Introduction

The paper presents a new Courseware Development Environment (CoDE). CoDE provides instructional designers with an easy to use yet powerful environment to develop online training. Students have the ability to access this training using a standard web browser. The course development environment is based on the Hyperwave [Maurer 1997] information server. Functionality of the server is considerably extended by the following components:

1. *Multimedia Editor* provides a possibility to create highly interactive learning elements with functionality which cannot be achieved in plain HTML format (like simulations, animations, answer-judging, vector graphic, dynamic screen transitions synchronized with sound clips, etc.). Such elements are called MM applets in the rest of this paper.
2. *Page Editor* provides a convenient way for authoring pages (i.e. basic elements visualized on student screen as indivisible chunk of learning information) by means of reusing existing elements. It should be especially noted that the Page Editor is not designed as an alternative to any of existing HTML editors. It uses a "template authoring paradigm" where existing HTML Editors can be seen as optional add-ons to provide basic elements of which a final product is assembled via an advanced GUI.
3. *Structure Editor* produces learning units by means of imposing a navigable structure on a top of existing collections of pages. It is based on the main concept of typed composites. Thus, there is a number of predefined templates (composite types) where users can simply insert existing pages or other composites to define sophisticated navigable structures.

This paper contains requirements and definitions for these three tools.

2. Data Elements of Online Training

Learning material won't be edited by instructional designers in the form of HTML pages. Instead, instructional designers edit the structure of learning units (learning unit -> page -> MM Element). It should be especially noted that all the three levels are optional and may be omitted if an author has a preferable alternative to implement the same task.

Thus, for example, authors may use MM Editor to create educational animations, but they are allowed to use any other tool like e.g. Macromedia Flash to perform a similar task. The resultant file, whether it is internal MM Editor format or another one, is available for reuse on the next level - Page Editor.

Similarly, authors may use Page Editor to assembly a page out of existing elements (HTML fragments, texts, images, movies, animations, etc.), but they are also allowed to use their favorite HTML Editors to create a complete HTML page.

Finally, authors are provided with an advanced structuring tool for automatic generation of a navigational structure by means of inserting/removing elements into/from learning units. Nevertheless, the authors are free to embed navigational elements (buttons, text anchors, etc.) into original HTML pages if they prefer so.

An addressable element is an object that can be requested by a student's browser with an HTTP request and is therefore "addressable" using a URL.

There exist two types of Addressable Elements: Learning Unit and Page.

- A Learning Unit is a collection-like unit that contains other Learning Units and Pages. Learning Units and Pages can occur in different Learning Units at different positions.
- A Page, the "atomic" element of learning units, is in fact not atomic because it can contain various media units and MM applets as it's paragraphs.

3. Authoring/Editing the Data Elements

3.1. MM Editor

The Editor provides a possibility to create highly interactive learning elements with functionality that cannot be achieved in plain HTML format. Functionality: the MM Editor works with so-called media objects. The following list of Media Objects is currently considered for implementation:

- Vector graphic (WMF and HMW formats);
- Still images (GIF and JPG formats)
- Movies (MPEG)
- Texts (plain ASCII)
- Sound (AU format)

The MM Editor allows to combine the MM objects into an executable form by means of the following operations:

- drag and drop objects into an editing area,
- resize a selected object,
- alter colors,
- edit content (texts and HMW format).

The MM Editor essentially adds a value to such imported objects by means of:

- Animating them on the screen;
- Inserting interactive elements like pauses or the possibilities for user's input;
- Allowing branches and loops;
- Dramatic transitions of the whole screen or its parts;
- Inserting conditions Analyzing User's input (Question/Answer Dialogue);
- Synchronizing active elements on the screen.

Technically the MM Editor is available in two forms - as Java Applet and Java Application. As a Java Application the Editor allows to select MM Objects or completed MM applets from a local drive or from a HyperWave server using unified "treeview" browser. The application will allow to save the resultant applets on a local drive or upload it to a Hyperwave Server.

As a Java Applet the Editor has considerable limitations on using local drive. It allows to select MM Objects or completed MM applets from HyperWave server only. The applet allows to upload resultant file into a Hyperwave Server. Additionally, the applet can be initiated in a special "edit only" mode which allows to edit existing MM applets residing on hyperwave server.

3.2. Page Editor

The Editor provides a convenient way for authoring pages (i.e. basic elements visualized on student screens as indivisible chunk of learning information) by means of reusing existing elements.
The Page Editor works with o-called page templates and page elements. A page template is a collection of cells. Each template's cell belongs to a particular type and defines:

- the operations which an author can apply to the cell;
- the position of a page element (or elements) on the user's screen;
- the appearance of the page elements on the user's screen.

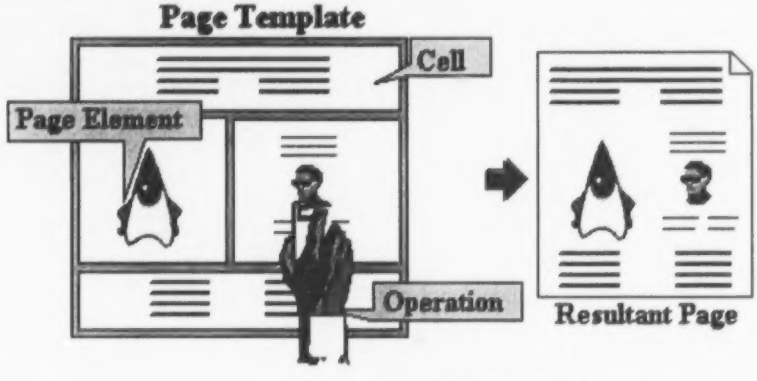

Figure 2: Page Template Components

The Page Editor supports the combination of page elements into a valid HTML document by means of operations which are applied to the template's cells. Thus, the main way of authoring is filling a page template with existing page elements.

There are the following cell types:

- Singular cell;
- Multiple cell;
- Macro cell.

The *singular cell* support the following authoring operations:

1. Drag and drop a page element from a local drive into the cell. Putting a new element into a particular singular cell replaces a previously defined element with the new one.
2. Double click the cell to define a new HTML or textual fragment.
3. Delete an element from the cell.

The *multiple cell* support the following authoring operations:

1. Drag and drop a page element from a local drive into the cell. Putting a new element into a particular multiple cell creates a sequence of elements.
2. Double click the cell to define a new HTML or textual fragment.
3. Move an element within the multiple cell onto a new position (change an order of elements);
4. Delete an element from the cell.

The *macro cell* contains a special macro which is activated when the cell is double clicked.

Normally, the macro requests a number of parameters from the author and generates a valid HTML fragment using the current values.

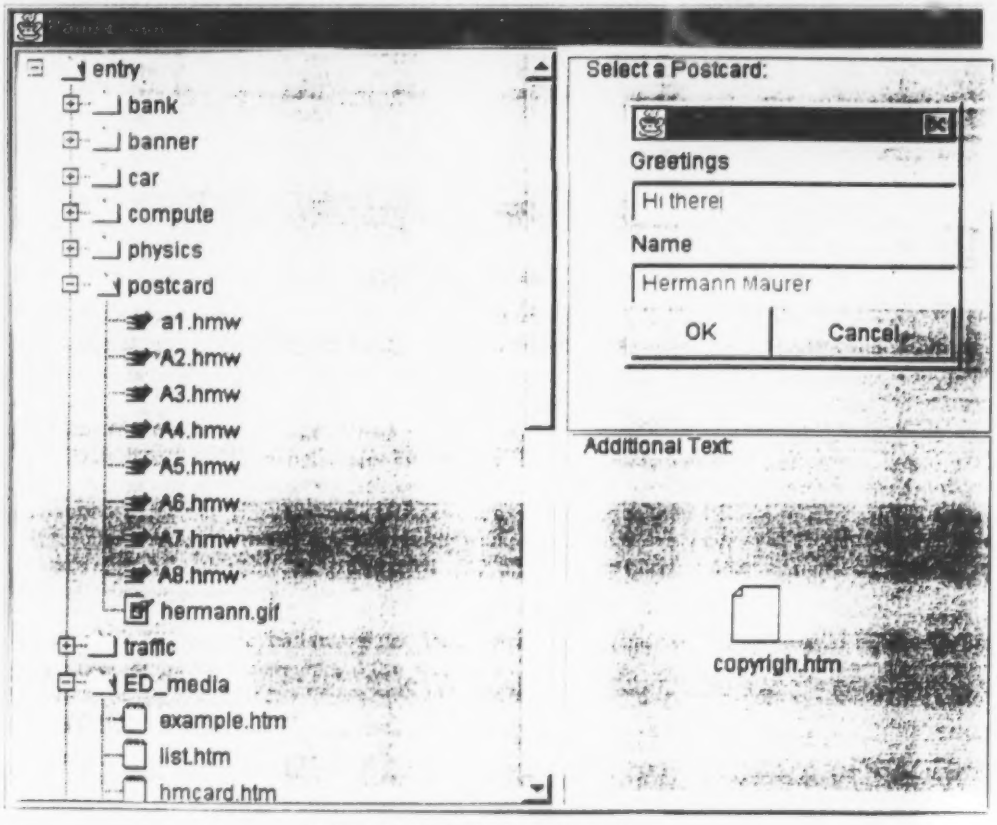

Figure 2: Activating a macro cell

Page elements are created with other editing systems. Generally, any MM format can be incorporated into a page created by means of the Page Editor. There are so-called *native* Page Editor formats and *author defined* format. The native MM formats do not require any additional definition and can be previewed by the page editor.

Author defined formats should be additionally described using a special notation. The following list of native formats is currently considered for implementation:

- HTML Fragment;
- Still images (GIF and JPG formats)
- Movies (Mpeg and Vivo formats)
- Sound (AU, WAV and Vivo formats)
- Plain Text fragment (plain ASCII)
- MM Applet in native MM Editor (see Section 3.1) HMW format.

The Page Editor adds a value to textual page elements by means of:

- Defining relative positions of page elements on the screen;
- Assigning a type to template cells (ordered list, title, footnote, etc.);
- Assigning a desired color and font attributes to text fragments.

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Technical Details: the Page Editor is available in two forms - as Java Applet and Java Application. As a Java Application the Editor allows to select Page elements from a local drive or from a HyperWave server using unified "treeview" browser. The application allows to save the resultant page on a local drive or upload it to a Hyperwave Server. The Page Editor also allows to edit existing pages residing on a hyperwave server.

As a Java Applet the Editor has considerable limitations on using local drive. It allows to select Page elements from HyperWave server only. The applet allows to upload resultant file into a Hyperwave Server. Additionally, the applet can be initiated in a special "edit only" mode which allows to edit an existing page residing on a hyperwave server.

3.3. Structure Editor

The Structure Editor provides a convenient way to impose a navigable structure on a top of existing collections of pages, thus creating a learning unit.

Functionality: The Structure Editor works with a so-called Learning Unit templates, pages and existing Learning Units.

Each Learning Unit is a Hyperwave collection having a number of additional attributes which are automatically assigned by the Structure Editor. Elements of a learning unit are members of the corresponding collection which are also automatically provided with a special set of attributes.

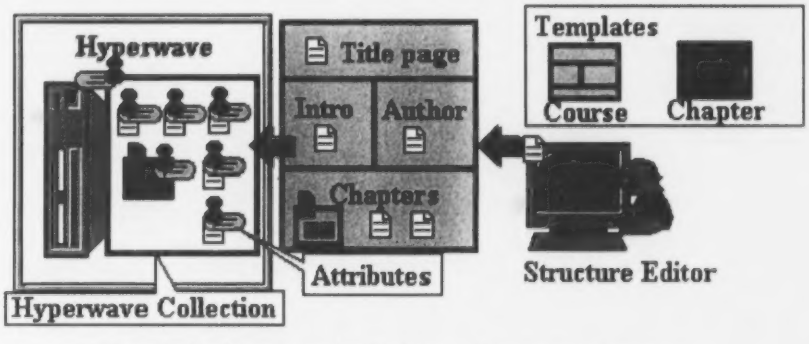

Figure 3: Saving a Learning Unit into a Hyperwave Server

Whenever a user accesses such learning unit with an ordinary WEB browser a special server-site Java script is run to visualize the unit in a form of interrelated HTML pages. The attributes attached to the collection and member documents are essentially used to control such vusualization.

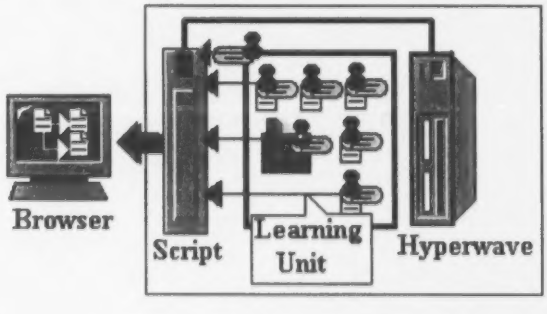

Figure 4: Accessing a Learning Unit

The main way of authoring is dragging existing pages and/or learning units onto a selected template. Pages are created with arbitrary other editing systems, i.e. they can, but need not , have been prepared using the Page Editor described in 3.2. All Pages must be in valid HTML format.

The Structure Editor allows to combine pages and existing course units into a new learning unit by means of the following operations:

- drag and drop objects into a template cell,
- answering questions generated by the template (e.g., would you like to create a reference to this element from the table of contents).

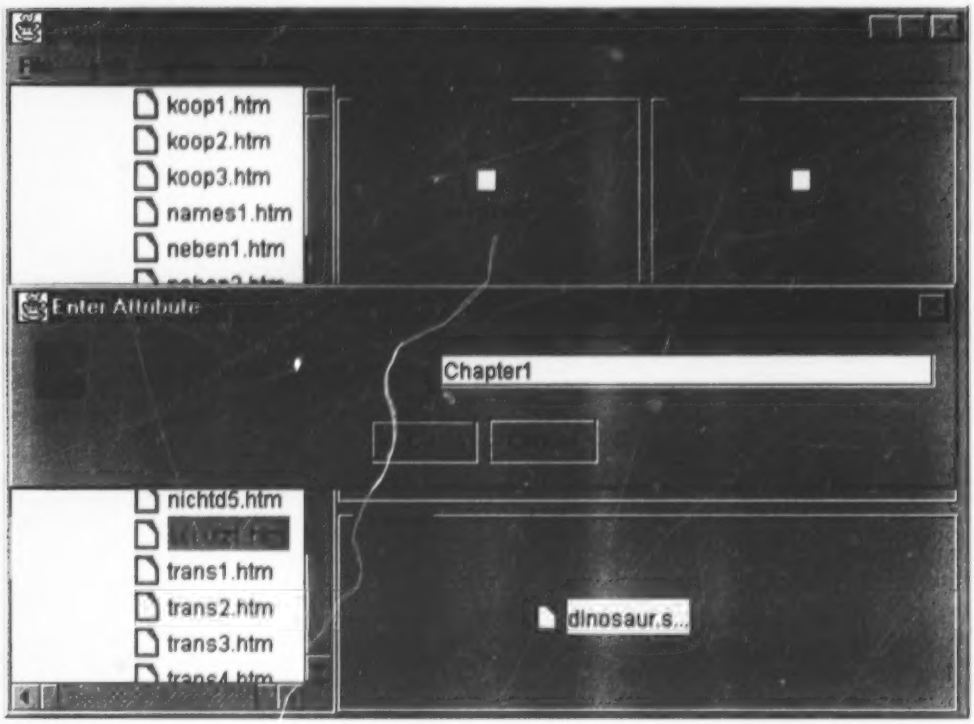

Figure 6: Editing a Learning Unit

Technical Details: The Structure Editor is available in two forms - as Java Applet and Java Application. As a Java Application the Editor allows to select elements from a local drive or from a HyperWave server using unified "treeview" browser. The application allows to save the resultant page on a local drive or upload it to a Hyperwave Server. The structure Editor can be also used to modify the structure of learning units that reside on a Hyperwave server. As a Java Applet the Editor has considerable limitations on using local drive. It allows to select Pages and/or existing Learning Units from HyperWave server only. The applet allows to upload resultant Learning Unit into a Hyperwave Server.

All the three editing components described above are based on a common tool that provides a unified access to a local drive or a Hyperwave server. This common tool, which is called "Tree View" in this paper, is used as an independent window for browsing existing materials by all three editors, it is also used for physical copying resultant files onto a local drive or uploading them into a hyperwave server.

4. References

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Use of the Internet by Small to Medium Enterprises in Singapore

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Abstract: The fact that the Internet is attracting so much attention and that more and more people are using it indicates a huge consumer market. This serves as a strong impetus for businesses to try to benefit from it. This study investigated the use of the Internet by small to medium enterprises in Singapore. It reports on the nature of usage of the Internet, the benefits associated with using the Internet for business and explores the role of business planning, Internet planning and resourcing in the success of Internet use.

1. Introduction

The fact that the Internet is attracting so much attention and that more and more people are using it indicates a huge consumer market. This serves as a strong impetus for businesses to try and benefit from it. In addition, the decentralised nature of the Internet is an attractive feature for businesses. No single firm owns the Internet. Instead, all firms can connect to the Internet and share in the capitalisation costs of providing backbone services. As such, firms need not raise all the capital required to organise, implement and manage the Internet [Kambril 1995].

There are many ways for organizations of all sizes and from different business sectors to use the Internet to facilitate electronic commerce. This is due to the Internet's current size and future growth prospects, and 'its ability to facilitate the global sharing of information and resources, and its potential to provide an efficient channel of advertising, marketing and even direct distribution of certain goods and information services' [Hoffman & Novak 1995].

However, despite the volume of literature advocating the benefits of using the Internet there are some concerns that could influence its success. One of the most pressing concerns is the lack of security. This is clearly reflected in user perceptions about security with potential customers very concerned about conducting financial transactions online [Gupta 1995]. As a result, the lack of security serves as a primary reason for not buying on the Web. Consumer risks also exist because of the fact that the Internet is not controlled by any single legal authority, leading to variance and inconsistencies in laws that affect consumer purchases. Finally, the fact that there is so much information available on the Internet implies that locating relevant and timely information can become a problem. Though web database search engines can help resolve this problem to some extent, much still needs to be done. However, instances of the Internet's inadequacies such as these do not seem to hinder its growth in popularity, and the Internet is potentially too valuable a business tool to deter active usage.

Little research has been done about the impact of the internet on small to medium enterprises (SMEs). Small businesses have traditionally been perceived as unable to afford the entry costs of electronic commerce [Murchland 1995]. However, the Internet may allow small companies to compete in a business environment where traditionally they have been strategically compromised by their limited resources. [Dou 1996] compared the use of Internet by small businesses in France with those in the United States. He acknowledged that the Internet enables 'information democratisation' where firms of all sizes can diffuse and access the same kinds of information on the Internet. Poon and Swatman undertook a series of studies on SMEs in Australia [Poon & Swatman 1996a] [Poon & Swatman 1996b] [Poon & Swatman 1996c] [Poon & Swatman 1997]. They found that the Internet was mainly being used for publicity and advertising and concluded that the Internet, while not being a 'silver bullet' that can solve all problems faced by small businesses, can still offer 'a relatively cheap, accessible and effective means of communicating ideas and information to trading partners, prospective customers and to rivals' [Poon & Swatman 1996c].

Although much has been written speculating on the potential benefits of using the Internet for business, relatively few empirical studies have addressed the impact of using the Internet on SMEs or considered what factors might contribute to success in using the Internet for electronic commerce. Singapore provides an interesting context in which such a study can be conducted. The country has been consistently ranked 2nd in terms of world economic competitiveness from 1994 to 1997 [Institute for Management Development 1997]. It also has a modern information technology infrastructure and strong government support for nurturing the use of the Internet. This study was designed to determine the nature of Internet use by SMEs in Singapore and to explore factors that might contribute to successful use. In particular the roles of business planning, Internet planning and resourcing on successful business use of the Internet are examined.

2. The Survey

The survey was conducted by questionnaire. The questionnaire contained 34 questions and was divided into 3 parts. The first part gathered background information on the SMEs. The second part was to be completed by SMEs that were using the Internet on a regular basis and included questions to investigate the nature of this usage. The final part of the questionnaire was to be filled out by SMEs that were not using the Internet regularly and was designed to elucidate the reasons why.

Questionnaires were sent out via e-mail to 644 SMEs in Singapore. This sample of SMEs was obtained from the SGConnect Web site which contains the details of businesses, many of them small to medium sized, operating in Singapore. All participants were promised a summary of the findings of the study as an incentive to participate. A reminder was sent to all SMEs that had not returned the questionnaire 3 weeks after the initial distribution and collection of questionnaires ceased a week later. A total of 91 questionnaires were returned giving a response rate of 14.1%.

Responses were received from businesses ranging in size from 1 to 250 employees with a median size of 10 employees. The small size of many of these businesses reflects how accessible the technology required for business use of the Internet has become and is consistent with a study by Poon and Swatman in which 65% of the SMEs responding to their survey had less than 15 employees [Poon & Swatman 1996c].

3. Internet Usage Profiles

A total of 81 (89%) respondents indicated that their organizations were using the Internet on a regular basis. [Tab. 1] shows the number of these organizations using each of the main Internet applications, the length of time for which the applications have been used, and the mean satisfaction ratings with the Internet applications. Organizations that were not using the Internet regularly for business purposes are not included in the results of this paper. Electronic mail was found to be the most commonly used application (used by all organizations that use the Internet regularly) and the WWW was used by 90.1% of those that use the Internet regularly. FTP (48.1%) and Newsgroups (30.9%) were used by fewer organizations. However it is possible that some of the organizations use the WWW to conduct e-mail, download files using FTP and to access Newgroups since the latest web browsers have these capabilities built in. If this was the case, the number of organizations who use FTP and access Newgroups may be higher than was indicated by the results.

[Tab. 1] also shows that Internet use is relatively recent, with the average period of use being only about a year and the maximum period about 2 years. This reflects the fact that Internet usage has grown dramatically in Singapore over the last few years. This is consistent with results from other countries. For example, in an international survey conducted by [Cockburn & Wilson 1996] the dramatic growth of Internet use by businesses was also evident.

Respondents were also asked to rate their level of satisfaction with each of the Internet applications their organization used on a Likert-type scale where 1 was labeled 'not satisfied' and 5 was labeled 'very satisfied'. Respondents appeared to be relatively satisfied with their usage of all the Internet applications. In particular, they were most satisfied with electronic mail (4.23) and least satisfied with Newsgroup access (3.27) (see [Tab. 1]). The results suggest that Internet usage is not a difficult activity for most SMEs to satisfactorily achieve.

Although only 27% of the organizations that responded to the questionnaire had information systems departments, 62% had personnel whom they considered to be relatively well experienced in using the Internet.

Internet application	Number using (%)	Length of usage (months) Mean	Min.	Max.	Mean satisfaction rating
Electronic Mail	81 (100.0)	13.9	2	50	4.23
WWW	73 (90.1)	12.2	1	48	3.86
FTP	39 (48.1)	13.5	3	48	3.74
Newsgroups	25 (30.9)	13.7	1	48	3.27
Other	12 (14.8)				

Table 1: Internet application usage patterns for those businesses that use the Internet regularly for business related purposes

Cockburn and Wilson identified the main purposes for business use of the Internet as: publicity, marketing and advertising; direct online selling; searching for and collecting information; and communication (including inter-organizational collaboration) [Cockburn & Wilson 1996]. [Tab. 2] shows the purposes for which the SMEs in this study used the Internet. It makes use of Cockburn and Wilson's categories. Communication with other businesses (93.8%) was the most frequently cited use of the Internet. This was followed by publicity, marketing and advertising (72.8%). Only a relatively small number of businesses were using the Internet for online selling (25.9%).

Purpose of Internet use	Number using	(%)	Mean effectiveness rating
Communication with other businesses	76	93.8	4.11
Publicity, marketing and advertising	59	72.8	2.97
Searching for information	38	46.9	3.71
Online selling of goods/services	21	25.9	3.00

Table 2: Purposes of Internet use of those businesses that use the Internet regularly

Respondents were also asked to indicate how effective they found the Internet for the purposes for which they were using it by rating its effectiveness for each purpose on a Likert-type scale where 1 was labeled 'not effective' and 5 was labeled 'very effective'. Respondents found communication with other businesses to be the most effective Internet use (4.11). This was followed by use of the Internet to gather materials (3.71).

Heavy use of the Internet as a communication and advertising medium is evident from the results of this survey. This is consistent with the results of other research (e.g. [Cockburn & Wilson 1996] [Poon & Strom 1997]). Direct online selling is still in its infancy in Singapore, with only approximately a quarter of the respondent organizations using the Internet for this purpose and with a relatively low effectiveness rating from those who did undertake it (3.00). It is possible that lack of security is a deterrent to online selling. Previous research has found that many consumers are still not comfortable with sending sensitive information (e.g. credit card numbers) over the Internet [Gupta 1995], and hence some companies are not asking them to do so [Cockburn & Wilson 1996]. This reflects the need to continually develop technologies that can provide more security for transactions over the Internet. Although the Singapore government has taken some steps to address this problem (e.g. Nettrust - Singapore's first certification authority for Internet commerce), it is possible that the effects of these initiatives have yet to be fully felt by SMEs. However that fact that the proportion of respondents conducting online selling in Singapore is greater than that found in Cockburn and Wilson's international study in 1996 suggests that electronic commerce over the Internet is gradually growing.

4. Benefits of Using the Internet

The majority of organizations that used the Internet regularly (72 organizations or 88.9%) believed that the use of the Internet was beneficial to their business. They felt that the major benefit from using the Internet was the increase in public awareness of the goods or services the company was selling (59.3%). This is consistent with the heavy use of the Internet for advertising. Other frequently cited benefits were the saving of time (54.3%) and a reduction in operating costs (43.2%) (see [Tab. 3]). The costs of advertising through the Internet and communicating through it are substantially less than the costs of conventional advertising and communication. It is also possible that respondent organizations felt that using the Internet as an advertising medium is much faster than organizing advertising through other mass media as there are fewer administrative overheads.

Few of the organizations regularly using the Internet believed that Internet use had actually increased profits (17.3%) despite a belief that operating costs were reduced. [Kambril 1995] claimed that to date the Internet is used mainly to displace communication and publishing costs and that this does not result in increases in revenue. He believes that more widespread use of direct electronic transactions and innovative revenue enhancing customer services will be required before businesses experience substantial revenue growth. In this study, only one third of the organizations using the Internet regularly believed that business processes had been improved. This may result from the recency of Internet use in most of the businesses.

Benefits	Number	(%)
Increase in public awareness of goods/services the company is selling	48	59.3
Time is saved	44	54.3
Operating costs are reduced	35	43.2
Improvement in business processes	27	33.3
Profits are increased	14	17.3
Other	8	9.9

Table 3: Perceived benefits of using the Internet

A minority of organizations that used the Internet regularly (9 organizations or 11.1%) did not feel that they could claim there had been any benefits gained from using the Internet. The major reason for lack of confidence was that no measurement of benefits had been conducted, so they couldn't determine if any benefits had been obtained (6 or 7.4%). Newness of Internet use (3 or 3.6%), lack of experience(3 or 3.6%), and lack of hardware (2 or 2.5%) were also cited.

These respondents were also asked why they continued to use the Internet. The main reason many respondents gave was a belief that 'getting connected to the Internet is the way to go in the future'. This suggests that many businesses are afraid of falling behind in the era of electronic commerce and are eager to explore any possibilities that the Internet may offer, even if there are no immediate benefits. This pattern of behavior was also observed by [Poon & Swatman 1997] in their case studies of Australian SMEs.

5. Factors that Contribute to Successful Use

It has been suggested that successful use of the Internet may depend on aligning the Internet strategy of an organization with its business strategy [Poon 1995]. In order to empirically explore the role of these factors and the role of resourcing, respondents were asked whether their organization had a business plan and an Internet plan and whether there was adequate resourcing for their use of the Internet. The results (see [Tab. 4] show that most of the businesses that used the Internet regularly had a business plan (71.6%) and many also believed that they had adequate hardware, software and personnel resources to make effective use of the Internet (65.4%).

Over half of the businesses also had an Internet use plan that integrated proposed Internet usage with their business needs and objectives (59.3%). However only 33% of the organizations had all three in place.

It was interesting to note that SMEs were not embarking upon online selling of goods and services lightly. Online selling was the one Internet use where a majority of businesses had a business plan and an Internet plan and adequate resourcing for their use of the Internet (57% of those involved in online selling).

Possible success factor		Total	Effectiveness of publicity, marketing and advertising		Effectiveness of online selling of goods or services		Effectiveness of information searching		Effectiveness of communication with other businesses	
			number	rating	number	rating	number	rating	number	rating
Existence of a business plan	yes	58	44	3.09	18	2.94	28	3.75	54	4.09
	no	23	15	2.60	3	3.33	10	3.60	22	4.16
Existence of an Internet use plan	yes	48	40	3.20 *	17	3.12	24	3.88	45	4.29 *
	no	33	19	2.47	4	2.50	14	3.43	31	3.85
Adequate resources	yes	53	37	3.16	15	2.93	28	3.75	50	4.07
	no	28	22	2.64	6	3.17	10	3.60	26	4.19
All of the above	yes	27	22	3.64 *	12	3.17	15	3.80	25	4.28
	no	54	37	2.57	9	2.78	23	3.65	51	4.03

Table 4: A comparison of mean effectiveness ratings for SMEs with and without business plans, Internet use plans and adequate resourcing of Internet use.
* $p < 0.05$

In order to explore the role that business planning, Internet planning and adequate resourcing might play in the success of business use of the Internet a comparison was made between the effectiveness ratings of those with and those without each of the possible factors that might contribute to success. Independent samples T-tests were used to compare the mean effectiveness ratings for the different Internet uses for each of the groups.

Respondent organizations that had both business and Internet plans, and sufficient resources gave significantly higher effectiveness ratings in the area of publicity, marketing and advertising ($t(57) = 3.68$, $p = 0.001$) but not for Internet use for other purposes.

It appears that publicity, marketing and advertising are more effective when the organization has laid the groundwork by establishing their marketing goals, identifying how the Internet can be used to help achieve them and providing the necessary resources. It is surprising that a similar result was not obtained for on-line selling but although higher effectiveness ratings were given by those organizations that undertook business planning and Internet planning and had adequate resourcing, the difference was not significant. This may be due to the small numbers involved in on-line selling.

The fact that no significant relationship was found between any of the 3 factors and effectiveness of use of the Internet for information searching or communication with other businesses may be because these activities are relatively straightforward and lack of planning may not have such an impact. Similarly, less resources would be needed to set up e-mail for communication and web browsers for information searching than would be required to set up a web site for advertising and marketing purposes.

The existence of a plan that integrates Internet usage with business needs appears to be the most influential of these factors (publicity, marketing and advertising: $t(57) = 2.27$, $p = 0.027$); communication with other businesses: $t(74) = 2.20$, $p = 0.031$). This supports the statement made by [Poon & Swatman 1996a] that 'small business wishing to harness the Internet for sustainable strategic advantage will need to align their business

strategy with their Internet strategy'. Thus, a business plan is needed to clarify business needs and objectives, paving the way for strategic activity aimed at fulfilling the objectives. It appears that organizations wishing to harness benefits from the Internet must first recognize what their business needs are. Similarly, organizations need to have adequate resources, in terms of hardware, software and personnel, to be able to use the Internet effectively.

6. Conclusions

This study investigated the use of the Internet by SMEs in Singapore. It found that use of the Internet by SMEs in Singapore is a fairly recent phenomenon but one with which there is a relatively high level of satisfaction. Communication with other businesses, and publicity, marketing and advertising are the major purposes for which it is used. Online selling of goods and services was found to be still in its infancy in Singapore and security issues may have to be addressed before it becomes a dominant form of business.

The role that business planning, Internet planning and adequate resourcing might play in the success of business use of the Internet was also investigated. Organizations that had both business plans and Internet plans plus adequate resourcing rated the effectiveness of the Internet for publicity, marketing and advertising more highly than did organizations without these. This indicates that SMEs should not rush into Internet use but rather should first lay groundwork by establishing their marketing goals, identifying how the Internet can be used to help achieve them and ensuring that they can provide the necessary resources.

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TeleCampus On-line Course Database

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Abstract: *The TeleCampus* on-line database aims to be the world's leading WWW site for students seeking information about on-line courses and programmes, and for educational institutions and training companies wishing to promote their offerings. It is a comprehensive multilingual online database of courses and programmes available worldwide on the Internet including primary, secondary, community college, university and specialised training courses. The database is limited to only those courses that can be taken fully on line from anywhere in the world that has an Internet connexion. An analysis of the available courses demonstrates that nearly 80% of these courses originate in the United States. More than 44% are at the university level. Fully 96% are in English. Other statistics are available. Interested parties can view the database at http://database.telecampus.com

Introduction

The TeleCampus online course database (http://database.telecampus.com) is a project of TeleEducation NB. It has implemented as a comprehensive online course database sponsored by Industry Canada, the World Bank, the Commonwealth of Learning, Le centre international pour le développement de l'inforoute en français, and other organizations. The online course database is a central repository of course information for students. Prior to the existence of the online course database, students wishing to access courses had to do some sophisticated searching. The on-line course database is the focus for any students wishing to take on-line courses as well as for any institutions and companies that wish to make their courses accessible.

Presently, there are more than 7 000 fully Web-based courses on line. In two years, we believe there will be more than 20 000. By being the first to establish a comprehensive on-line course database, we hope to capture the loyalties of students and institutions and become the world's on-line course centre. Educational institutions and training companies from many different countries are beginning to offer courses and programmes on line using the World Wide Web. Students can now take these courses from anywhere that has an Internet connection, without being bound to any specific time, place or institution.

Background

The *TeleCampus* initiative was approved by the Regional Development Commission of the Province of New Brunswick (RDC). *The TeleCampus* is managed by TeleEducation NB, the provincial distributed distance learning network, a section of the Department of Education. *The TeleCampus* included the on-line course database project as part of its original marketing strategy. The on-line course database, which was originally envisioned as a marketing tool, is seen now also as a possible for-profit venture which attracts not only students and institutions but also external funding through advertising and investment capital.

This initiative is also seen in the context of the national strategy to prepare Canadians to meet the challenge of globalization. This is outlined in the Canadian government's action plan [Government of Canada 1992], where it is recommended that Canadian educational institutions and training organizations should market more extensively in other countries emphasizing niche areas like distance education and information technology in which Canada excels [Industry Canada 1997].

The *TeleCampus* now hosts and maintains a comprehensive multilingual online database of courses and programmes available worldwide on the Internet including primary, secondary, community college, university and specialised

training courses. It has been initially developed and designed in English and French. It will be extended to other language users as partnerships develop with institutions abroad.

As of spring, 1998, nearly 78% of the courses originated in the USA. Canada was the place of origin for 18% followed by the UK (2%) and Australia (1%). Other countries with online courses include France, South Africa, Sweden, Ireland, Japan, New Zealand, Belgium, and Bangladesh. Nearly 44% of courses were from universities. Community colleges accounted for 16%, K12 (11%) and more than 25% were from the private sector. More than 96% of courses were in English, 3.7% are in French and only 0.3% in other languages.

On-Line Course and Program Taxonomy

An on-line programme or course is defined as one that can be followed completely on line. This does not mean that all course materials need be on line. Books, CD-ROMs, video and audio tapes, laboratory materials etc. could be shipped out directly to students. Examinations may be taken at local institutions or testing centres. The database excludes courses with no on-line component as well as those that require residency.

On a continuum, the courses and programmes that are advertised on line continue thus:

Courses with no or limited distance availability:

1. Classroom-based courses with no on-line features;
2. Classroom-based courses with some materials available on line;
3. Classroom-based courses that integrate on-line materials;
4. On-campus courses that are on line but are not available to distant students;
5. On-campus courses toffering limited access to students at a distance (often limited to one region)
6. Teleconferencing courses where students must participate from specified learning centres.

These represent the majority of courses presently advertised. They are not included in the database because they require residency, either on campus or near an accessible learning centre.

Correspondence Courses (print, audio and video tapes, software)

7. Print-based correspondence courses using the postal system with minimal student support;
8. Print-based correspondence courses with continuing access to a tutor by telephone.

These also would not be included, as they are not available on line.

All of the following class of courses are included in the on-line course database:

9. Print-based correspondence courses also using email for tutor access;
10. Correspondence courses with course content available on line in electronic format.
11. CBT- based self-study courses with access on-line to an instructor.
12. CBT- based self-study courses with no instructor.

These courses represent the most primitive form of on-line courses.

Computer-Mediated Conferencing (CMC)

These courses often include texts and sometimes include audio/video tapes, and computer software possibly including Computer-Based Training courseware. Students may need to download and install client-side software to participate.

13. Courses that use email for submission of assignments and private tutoring and email lists or listservs for discussions and tutoring;
14. Courses that use CMC software for discussions as well as email for submission of assignments and private tutoring;
15. CMC courses with all content, audio/ video, and software available on line; students can download and print out content or read it on line.

Hypermedia on the World Wide Web

These courses can be followed on line on the World Wide Web. They take advantage of the links to other relevant sites using subject trails and other techniques. These courses can be either text-based (and so available to students with older computers and/or low bandwidth connections) or they can include graphics and animations that require a more powerful computersd and higher bandwidth.

16. Courses that use hypertext links and have all necessary course materials on line.
17. Courses with hypermedia links with Multimedia using *Shockwave*, or other applications.

On-line courses need to be further divided into those in which the course materials can be accessed using a standard web browser (Netscape or Internet Explorer) and those that require students to download and/or install a client-side application. This can be quite troublesome for students. Some plug-ins like *Shockwave* and *Quicktime* are becoming standard and might be considered as normally available. Others however are non-standard and can be problematic.

Various permutations of the taxonomy described are possible. For example any Multimedia web course might also have a text component. A CMC course could have some hypermedia links and a workbook. A correspondence course could incorporate some multimedia courseware on a CD-ROM with hyperlinks to the World Wide Web.

In order to limit the size of the database and make it more useful to on-line students, this project limits the course selection to those courses and programmes that are universally available on line. That is, those that can be taken from anywhere in the world where there is an Internet connection. If a student is in Johannesburg, Rio de Janeiro or Kuala Lumpur and has a reliable Internet connection, he or she should be able to enroll in any course in the database.

Database Description

The database provides a full-text search engine for users who can search using categories such as Programme, Course, Level, Institution, Country, Region of Country, State/Province etc. A Subject list is also present for students who wish to search by category. For example: Biology, Architecture, Classics, Computer Technology. For more detailed information, users are directed to the institutional web sites. The aim is to keep the database as simple and useful as possible for users. It has been implemented in Oracle 7.6 in a robust web-accessible, multi-user environment. The database is open so additional fields can be added as needed.

The fields conform to *ISO Standard 11179* as developed by EduCAUSE's Instructional Management Systems Project (http://www.imsproject.org/) As such, each field contains the following metadata attribute descriptions: *Name, Definition, Obligation* (whether or not the field is mandatory, conditional or optional), *Data type* (string, alphanumeric, etc.), *Length* (number of characters), *Default value, Permitted values, and Comments* .

In addition, student support pages and tutorials are included, for example: counseling students on the attitudes and aptitudes needed for on-line study; basic on-line study skills; the implications of accreditation; student aid links; links to on-line resources for students; on-line library links etc. A student CMC discussion area, and a listserv open to all on-line students is also being made available. A WWW form is supplied for institutions to input information on their courses and programmes according to the standard format. Institutions are encouraged to use it.

Rationale

A normal analysis would not be particularly useful for *the TeleCampus* on-line course database initiative, as we are projecting into a future that has no precedent with few comparisons. The exponential growth in activity of all kinds on the Internet is however leading to increased demands for on-line education and training. The number of courses available on line has increased from less than fifty in 1996 to close to one thousand last year. More than ten thousand could be online by 1999, and over one hundred thousand by 2005. This represents an increase in the number of students from less than a thousand to more than a hundred thousand in 1999, to more than a million by 2005. In addition, untapped world wide markets are only now developing. Any estimate of market size will be in error, and any attempt at a "snapshot" of the market at any particular time will be outdated on the following day. Undoubtedly, students need a user-friendly service for accessing these course offerings as well as both specific and general information about courses, institutions, accreditation, distance learning, and studying on line.

Although it is difficult to gauge the commercial potential of on-line educational databases, we can check out on-line businesses that specialise in various niche products. They are among the few that are making any money on line. Noticeable exceptions are the various search engines like Yahoo, Excite and Alta Vista. Their large critical mass of users attracts advertisers who can target specific markets depending on the search terms entered by the users [Hagel & Armstrong 1997].

Many successful sites (not necessarily money making) are based on creating a focal point for specific content created by the owner. For example, Phil Greenspun's site (http://www-swiss.ai.mit.edu/wtr/) [Greenspun 1997]. Others like the *Training Supersite* (http://www.trainingsupersite.com), and *Travel.com* (http://www.travel.com) collect links to other relevant sites. Other sites provide a valuable service like Don Stroud's collection of downloadable utilities and reviews (http://cws.internet.com/) or *Amazon* "the world's largest bookstore" which will find any book that is requested.

One key to creating a successful site seems to be reaching a critical mass of users with a particular profile that is attractive to advertisers. The more information and services a company provides, the more likely it is to attract the number of users that will make a site commercially viable. The challenge for *the TeleCampus* is to create a dynamic resource attractive to the ever increasing number of people who are exploring the possibilities for on-line learning.

One strategy is to aggregate vendors and users under a common umbrella, and create an on-line centralised information and service centre providing convenient access to a wide variety of vendor products and services. See Pennwell Media's *Broadband Guide* (http://www.broadband-guide.com/) for broadband professionals or Jumbo Inc.'s *Jumbo* web site (http://www.jumbo.com) for shareware customers and vendors. "Prominence – not dominance is the rule." Chuck Martin (1997, p.188) reminds us. Value is created when specific types of users and resources of interest to them are aggregated

These sites serve as magnets, bringing together customers who possess common purchase profiles. The sites attract a significant percentage of the buyers in any niche area. Thousands of these sites are attracting people because they are providing a structure that makes it convenient for customers to access information about, and purchase, the products that they desire. These magnet sites provide customers with more facts about particular niche areas than they could possibly access otherwise. New customer power bases are developing based on the large numbers congregating in electronic centres. The site serves as an agent for the users who frequent it. It can defend their interests and influence vendors to ensure that they augment their services. For example, "reverse markets" are now possible where customers, armed with information can coax or cajole vendors into bidding for the opportunity to sell their products and services.

Visitors are the principal economic asset of these sites. The value of a site increases exponentially once a critical mass of visitors is attained. This can take some time and no doubt will not happen right away. However, as more people visit, more are attracted. This can lead to a reinforcing cycle of activity that compounds the number of users causing a massive surge in user growth. These new users contribute even more content and increase the value of the site further which again leads to even more users.

However, initially there can be an extended period of linear growth before the exponential reinforcement cycle sets in. As a consequence, investors in WWW sites cannot expect a quick return on investment. If one charges user fees, then this could stunt growth and make reaching a critical mass of users impossible. Advertisers may not be interested until the critical mass is reached. Therefore, near term revenues should not be expected. A site either generates a large amount of traffic or provides vendors with valuable information on a limited number of users. Either one will take time to gather.

As users represent the primary asset of a WWW site, a conscientious way to attract and keep them is to advocate their interests. A successful site leverages the power generated by the users to give them an advantage. Shared information about vendors' products, ratings, and access to a wide range of choice are some of the ways in which users can benefit. In addition, as an agent for users, fighting for their interests, a site becomes a focal point for the exchange of information of relevance to the group. Value is then derived from the opportunities to sell to the niche audience and to sub-niches of specific information seekers. Detailed transaction profiles can be generated and sold to vendors.

Microsoft, *NCSA Mosaic* (the predecessor to Netscape) and other companies provide us with textbook examples of the consequences of exponential growth. The *Mosaic* browser was created by Marc Andreesen and other students at the University of Illinois and was distributed free-of-charge to anyone who wanted to use it. The key creators then teamed with businessman Jim Clark to create *Netscape*, an even better browser which was again distributed freely. It went on to capture over 90% of the market. *Netscape* then started to charge for their product while providing it free to educational institutions. Capitalising on their reputation, and the critical mass of users of their browser, *Netscape* attracted investors and developed revenue streams from selling their server and other software to businesses, and from advertisers attracted by the high volume of visitors to the *Netscape* Web site. (http://www.netscape.com)

Yahoo! is one of the Web's leading search engines. It was developed by Jerry Yang and David Filo when they were graduate students at Stanford in 1994. It was one of the first tools that helped users access in a structured fashion the vast amounts of data becoming available on the WWW. It was made freely available to all users and has continued as a free service. When a critical mass of users was reached after a relatively short period of time – less than two years - investors and advertisers became interested and helped to turn it into a profitable enterprise. (http://www.yahoo.com)

Both *Netscape* and *Yahoo!* took full advantage of the features of the WWW environment to expand their businesses. Rather than waiting until a perfect product was created, they distributed imperfect *beta* versions and learned from the feedback provided by users. Their research was conducted through their early releases. They put their products out quickly without relying on long discussions, consulting, meetings, strategic plans and creating rigid structures. They made

alliances from the beginning and remained fluid rather than adhering to a fixed business plan. They rely heavily on the technical proficiency, adaptability and abilities of their staff.

Growth on the net mimics nature, proceeding linearly until it reaches a critical point, after which the accomplishments begin to foster even more successes. Once DOS and HTML became accepted as standards, their growth took off. In the information technology arena, even more than in other fields, the rich get richer [Kelly 1997].

A WWW niche site must also attract a critical mass of visitors before it will "take off" and grow exponentially. Established sites discourage others from entering the field, so those who get in first and attain critical mass quickly will pre-empt competitors. Those who enter early become entrenched. A "lock-in" occurs based on their unique assets. Users do not like to switch from the known and familiar. A much larger investment is needed to catch up with and exceed the quality of the established business. The price of start-up is simply too great for all but the most serious competitors. Those who attempt to set up later find it to be prohibitively expensive. While niche WWW sites do not require large capital investments in the beginning stages of an industry, indomitable barriers make it increasingly more difficult for those who start later [Martin 1997].

The best technologies whether hardware or software get cheaper every year. The price of telecommunications bandwidth is also dropping rapidly. This drop in prices resembles an asymptotic curve that continually approaches zero without ever reaching it. Similarly, on the web, businesses are successful by offering products and services for free. When one product is free, other products and services can be positioned around it for sale.

Usage and transaction information capture is likely to be a major engine for economic growth. Successful on-line businesses develop deep skills early in the extraction of commercial value from member usage and transaction profiles. However, they use this information to develop the position of champion of their users' interests rather than as a representative of the vendors. By adopting this position, the site organiser becomes a protector of the users' usage and transaction profiles and not a conscious surrogate of the vendors.

This analysis suggests that there is a role for *the TeleCampus* on-line course database as a central virtual meeting place for students and institutions, and that a business case can be made for ensuring its sustainability and profitability. Other sites that offer indexes of courses offer access to a wide range of on site, online or videoconferencing courses. Students afe often frustrated when they find a course they want only to discover that there is a residency requirement or that there is another stipulation that makes it difficult to take online. There is a listing of other indexes available at the TeleEducation NB website (http://teleeducation.nb.ca).

Conclusion

The potential need for *the TeleCampus* on-line course database is enormous. On-line learning is a growth industry. Compare this database initiative with another one like Yahoo!, which started out as a fun tool created by students. The potential was seen by investors, who worked with the original team to turn it into a successful commercial enterprise. It is now a multimillion dollar operation. The world student population is huge. As more and more of them become attracted to on-line learning possibilities, they will be searching the Net for courses. Our database will attract them. Advertisers will want to reach them. In addition, this database can be seen as a worthwhile economic aid project as it benefits students and organisations from all over the world. The service is offered to students free of charge. Basic listing by institutions is also available free of charge.

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Authoring Tools for Interactive Web-components

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Abstract: This paper addresses the development of 'web-components' which take advantage of client-side programming (Javascript) to provide enhanced interactivity and functionality for a specified purpose. The components manipulate collections of structured data. Exemplar component types are site navigation components, a tour component (sequential presentations of an ordered list of pages), an electronic catalogue and ordering system component, and an interactive exercise component for self-testing (quiz). A model of each component type is adopted. A set of authoring tools is introduced to facilitate the structured creation, configuration, and management of these components. The authoring tools generate instances of the web component objects. An instance consists of a HTML-based graphical user interface, one or more data files containing the content, a Javascript runtime engine and a set of parameters specifying functional and presentation characteristics for the component instance. Developers can concentrate on the semantics of the model being implemented rather than the underlying HTML and Javascript coding. Finally an integrated authoring environment is proposed, based on an extensible set of plug-in component types and a shared semantic framework.

1 Introduction

It is generally accepted that the task of producing hypermedia can be split into two distinguishable activities, those that deal with the content on a per node basis, viz. Authoring-in-the-Small (AIS), and those that deal with larger scale structuring viz. Authoring-in-the-Large (AIL). Authoring tools addressing these activities are a fundamental topic of research on multimedia and hypermedia systems. Many authors have approached the development of mechanisms and tools for representing more complex or structured information in hypermedia documents and for simplifying the development and maintenance of hypermedia web-based systems. Various approaches have been proposed such as the extension of HTML to introduce semantic markup (e.g. [Dobson and Burrill 1995]) and Schema-based structuring (e.g. [Garzotto et al 1991] and [Kesseler 1995]), combining these with authoring tools for automatic HTML generation. The way in which information can be organised or structured, and how it can be navigated is a central issue. The organisation of content often has an implicit primary structure which is usually hierarchical from general to specific. With hypermedia linking a secondary network of referencing can be superimposed. Some authors (e.g. [Garzotto et al 1991]) argue that a clear distinction exists between these *organizational links* and *referential links*, while others (e.g. [Kesseler 1995]) have argued that "their seemingly different semantic weight is in the eye of the beholder". Kesseler acknowledges that the problems of hypertext authoring are augmented by the introduction of dynamic runtime behaviour and programming.

With greater degrees of client-side functionality being added, a web site can be considered as a logical hierarchy of inter-related but independently functioning interactive information subsystems or components. The distinction between *organizational links* and *referential links* is made explict, and different physical linking mechanisms may be used. Each semantic component may physically consist of a collection of dynamic semi-structured data items, with its own internal behavioural rules, and presentation characteristics. The component content is defined as semi-structured since external references via hypermedia links can be included in the content.

This paper concentrates on how dynamic client-side interactivity can be harnessed, and tools developed to aid in the construction of component subsystems. The authoring of these interactive components is a form of AIL which focuses on the specific internal structure and behaviour of the collection, but the way in which a component relates to the web at large must also be addressed. The tools encourage top-down stepwise design

and development, focusing on the logical objects and hiding physical implementation mechanisms. This structured approach will result in greater productivity. Also, many useful applications of interactive WWW documents relate to areas best addressed by those who have expertise in the relevant area but without the required level of technical internet development skills (computer-based learning is a prime example): simple authoring tools address this need. Automated generation of document content is widely established. Automated generation of interactive functionality offers much potential scope for enhancement of both the documents developed and the development process itself.

Client-side programming of dynamic behaviour has a number of benefits over the CGI based implementations. Javascript has low overheads and small code size, which is important given bandwidth limitations. Good runtime performance results in a high degree of responsivity and usability for the end user. It is client-based and this server independence frees the developer from the overheads of server-based implementations. This is especially suitable where the site is hosted by a third party such as an internet service provider (ISP). Client-side Javascript is not suitable for handling large volumes of data or highly dynamic data. This is the domain of Java applets or server-side CGI programs.

2 Requirements

The goal was to produce a set of simple authoring tools which would speed development, lower the entrance requirements and help users avoid syntactic, functional and stylistic errors. The following were deemed to be important requirements of the tools and components

- users should need little or no familiarity with HTML markup, Javascript, CGI programming or databases
- independence from server platform implementation considerations and constraints
- flexibility, allowing variation of format and stylistic customization
- should be open allowing the user's preferred Web page layout or HTML editor and any Javascript compatible browser to be used in conjunction with them
- should incorporate features to manage and maintain the component documents over time

An iterative approach was followed in designing the components and tools based on the following stages:

- Model definition produced for each component type.
- Exemplar web application, based on the model, was constructed by hand.
- Generalisation and refinement of the runtime implementation mechanisms.
- Development of an authoring tool to automate production of the component.
- Review of the tools and components
- Refinement to allow for greater flexibility, customisation, reusability and to improve efficiency

3 Runtime Components

3.1 Architecture of a Runtime Component

The semantic model for a component consists of a structured data description and a set of preferences which determine functional and representational variants. The authoring tools generate instances of the web component objects. Aspects of the generation of HTML for displaying individual data items within a collection are delegated to the runtime engine.

A component instance consists of:
- a graphical user interface
- one or more data files containing the content
- Javascript runtime engine
- set of parameters specifying functional & presentation characteristics of the component instance.

The runtime engine is responsible for extracting the required data, in response to interface actions. The engine must then wrap this data in HTML according to predefined layout conventions or parameters. Any

interactivity associated with the data itself require appropriate calls to the engine to be incorporated. The final result is then written to the target frame or window and rendered by the browser.

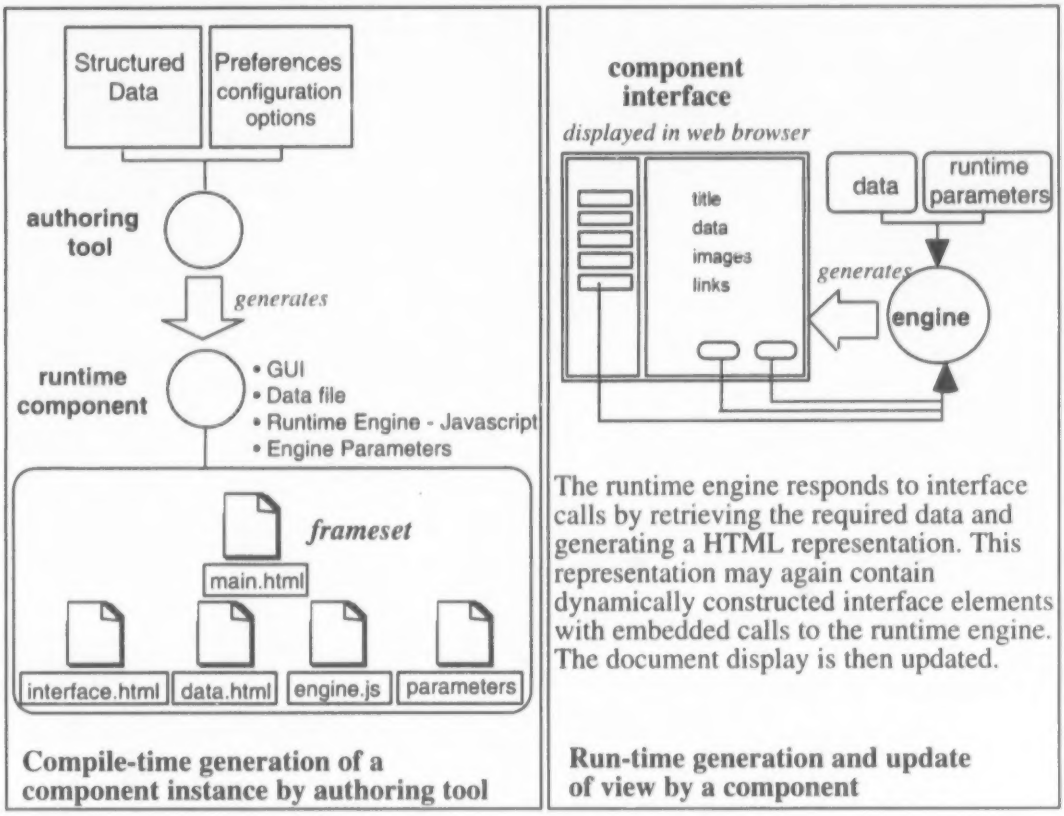

Figure 1: Typical compile-time and run-time processing

3.2 Automatic Generation of Runtime Components

This requires the logical data structures as maintained by the authoring tool to be transformed into HTML with appropriate interface controls and Javascript functionality being embedded or referenced. The process is divided into four main stages:

- generation of 'controller' frameset HTML file
- generation of content data
- generation of and passing of runtime parameters to the Javascript engine
- generation of main interface frame file(s).

4 Some Exemplar Components

4.1 Slideshow Presentation Component

This is a slideshow style of sequential navigation through a list of web-pages, i.e.

presentation = index.
index = {slide}.
slide = title, URL [, Notes URL, Description]. // optionally [,sound annotation]

The index is a list of slides. Each slide entry has a title, a content page, and optionally an associated notes page and description. A control panel is displayed with index, first, last, next, previous, back, and forward navigation buttons. A text field displays the current slide number and a position can be entered in this field to move the presentation on to a specific slide. The slide and information buttons toggle between the slide and any supplementary notes page.

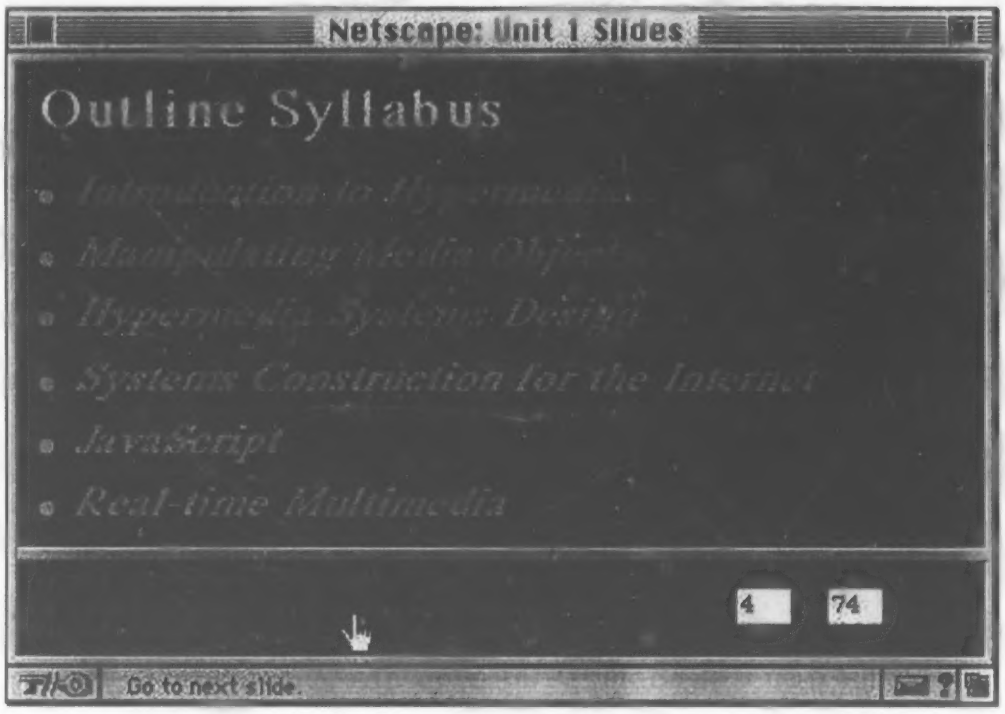

Figure 2: a slideshow presentation component

An existing web page can be passed to the authoring tool as an index. The links in the page are simply extracted in sequence and slide entries created for them. This feature allows bookmark files to be used, thus a tour using the browser can be an effective way to build a presentation sequence. The individual pages associated with each node can contain multimedia elements. The structure itself could be extended to permit a speech-based annotation to be associated with a node. The option of having sound on or off could then be delegated to the user via an interface control element. The control layout, the buttons included, and the style used can be customized.

4.2 Electronic Catalogue and Ordering System Component

The catalogue component is based on a simple printed catalogue or brochure metaphor. The catalogue is made up of sections (or categories of products) containing lists of product descriptions.

Catalogue	=	{Section }, Preferences.
Section	=	Title, Image, Description, {Product}.
Product	=	Name, Code, Price, Image, Description, Related information (URL).
Name, Code	=	String.
Price	=	Real.
Image, Related	=	URL.
Description	=	text/HTML.
Preferences	=	PricingOn [, CurrencySymol] , TaxOn [, TaxRate], OrderingOn.

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[,OrderAddress], CustomControlsOn [, ControlsGraphicsDirectory, background, bgColor, textColor].

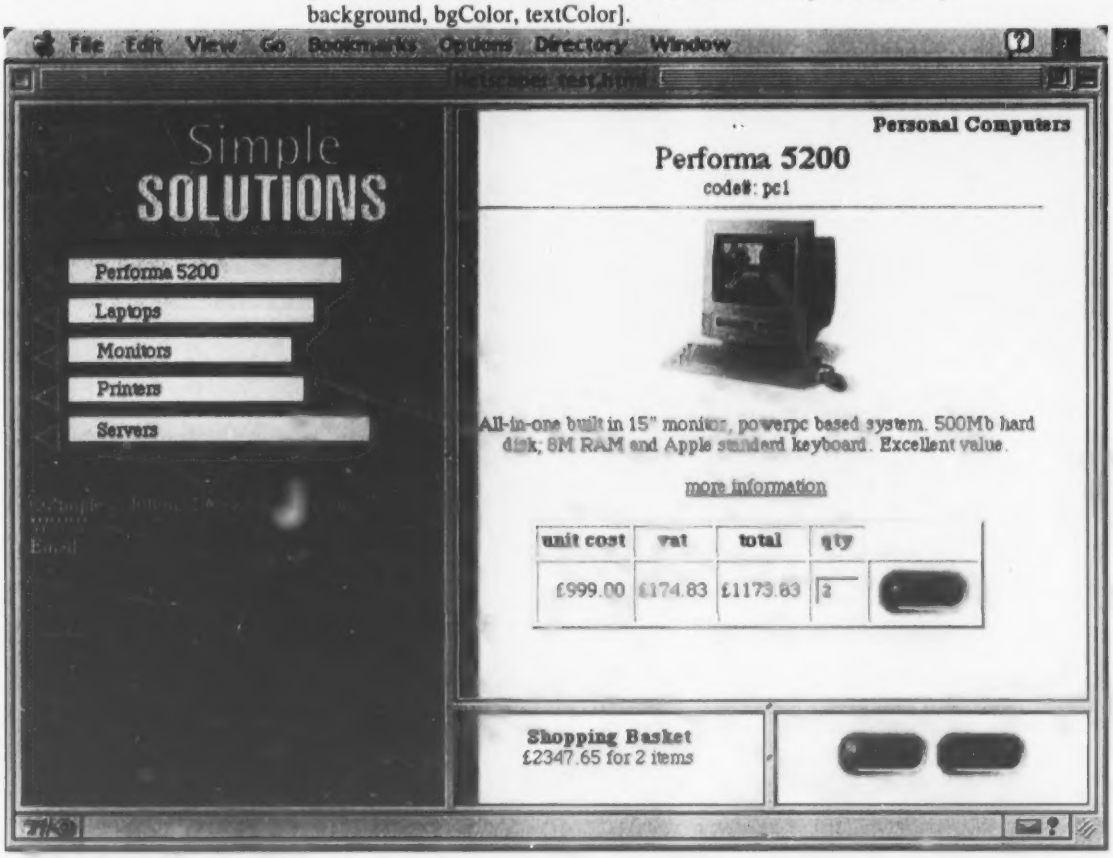

Figure 3: a catalogue and ordering system component.

The user can browse interactively through the catalogue via an index of popup menu product selectors for each section. A shopping basket facility is included allowing items to be added and removed from the basket. An order form can be generated. On completion of the order form customer details online ordering can be provided. The developer can specify ordering by printing and faxing form, by email or via a CGI script (e.g. formmail, or an order database front end). The entire product data file is downloaded, but the product images are loaded as required. Users can turn off product image display in low bandwidth conditions.

The authoring tool for this component provides facilities for maintaining the product information, updating the prices, converting between currencies and customising the layouts, graphics and controls.

5 Advantages and Disadvantages of the Tools and Components

The components enhance the features and functionality of WWW documents and sites. The Javascript runtime components offer high usability, are resource efficient and responsive. The scripts are small offering low bandwidth overheads.

The authoring tools provide simple point-and-click interfaces complementing a higher-level approach to the development of interactive web documents while minimising the requirements for technical knowledge of internet development languages and mechanisms. They enforce a greater separation between content, presentation characteristics and functionality. This allows users to focus on the logic and content of the component rather than on the HTML and Javascript. Incremental development gives users the flexibility to

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develop as much as time or desire permits. Users may begin with a simple outline and as time and other resources permit, develop and extend the contents, and fine-tune the stylistic or presentation attributes of the object. It is believed that this will greatly reduce the amount of time required to create a component.
The tools aim to build on top of and integrate with existing systems, supporting the import of HTML created by any HTML editor. Similarly the user can choose their preferred browser as the viewer. While allowing considerable freedom in determining the structure, behaviour and style of a component, this type of software is not possible without enforcing some standard structuring and interface layouts. Added flexibility and customisation options may be added at a later date. The web components as they stand do not offer dynamic data update; when an update to the underlying data has been performed the executable component must be regenerated.

6 Summary and Future Directions

The tools demonstrate that the process of creating interactive components incorporating hypermedia links can be simplified. Rapid incremental building of interactive web components can be supported. Construction of the component is focused on the characteristics of the object in question not on page construction as many other tools require. Many useful interactive components have been developed. Maintenance of the components is also simplified by providing facilities for easy update and reconfiguring of behaviour and style.

A problem with any authoring tool lies in finding viable ways to maintain and extend it over a sustained period of time. Ultimately users require tools which can evolve to match developments in the problem domain that the tool purports to address. This is particularly so with regard to the world-wide-web with technology and standards developing rapidly. As such these tools represent a small step forward in the top-down structured development of interactive web-sites. In order to allow rapid take up of new developments, in a consistent manner, the tools themselves need to be built around a shared open framework supporting reusability.

An integrated development environment is proposed which is based on an extensible plug-in architecture supporting unlimited web components types. Development of a site or domain is based on building a logical tree of components. Editing of individual component types can be delegated to the individual component editor for that type. This extensible open environment is seen as a method of addressing the maintenance problem. Individual web-component types can be modified and new ones added. Dynamic data access management can be provided by adding Java applet support and by combining Javascript with embedded applets.

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Individualizing Web Based Hypermedia Learning Environments

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Abstract:
This study attempted to determine what combination of nonlinearity and advance organizers worked best for learners with given levels of self-regulation. While the results of the study showed no significant main effects or interactions, there were two near significant interactions; between nonlinearity and self-regulated learning ($p = 0.054$) and between nonlinearity and advance organizers ($p = 0.052$). Data analysis of achievement measures showed two near significant ($p = 0.05$) interactions, between advance organizer by level of nonlinearity and level of nonlinearity by self-regulated learning. While the results were not statistically significant, they suggested relationships that can be examined in further studies.

Purpose of the Study

Learning systems function best when they adapt to the needs of individual learners [Park & Hannafin 1993]. Technology based learning environments offer educators the ability to individualize instruction for learners consistently and automatically. Learners derive the most benefit from a technology based learning environment when the capabilities of the environment are used to perform or model tasks that are important to learning and that the learner cannot, or does not, perform herself [Kozma 1991]. In order to take full advantage of this ability it is first necessary for researchers to determine which instructional strategies, or combinations of instructional strategies, work best for learners of a particular profile. In this study, nonlinearity of instructional presentation and advance organizers were examined in relationship to learner self-regulation in a web based hypermedia learning environment.

Design

The study was a 3x3x2 ANOVA. The instructional environment for the study was *Operating Systems Basics*, a web based tutorial on the basic functions and operations of the Windows95™ and Macintosh™ personal computer operating systems. There were two treatment and one classification variables for the study. The classification variable was the level of learner self-regulation as measured by scales from the Motivated Strategies for Learning Questionnaire (MSLQ) [Pintrich and Garcia 1991] modified for use in a hypermedia environment. The treatment variables were both instructional strategies that can be applied in web based instruction. They were the level of nonlinearity of instructional presentation (of which three different levels were used) and the presence or absence of advance organizers. In order to test these instructional strategies, it was necessary to create three different presentations of the same content with different levels of nonlinearity. Each of these presentations was further separated into those with advance organizers and those without. The dependent variable was learner achievement as measured by a two-part post-test. One hundred and nineteen undergraduate students were randomly assigned to one of the six different hypermedia instructional treatments. The students were also tested for self-regulated learning and split into three groups based on their scores.

Results

The data were analyzed using a three-way analysis of variance (see Table 2). Table 1 shows the achievement means and standard deviation for each cell.

Table 1: Group Achievement Means.

	Low SR		Med. SR		High SR	
			No advance organizers			
	Mean	SD	Mean	SD	Mean	SD
Low NL	27.67	4.04	29.67	1.50	22.17	6.34
Med. NL	22.80	9.04	25.78	5.45	23.75	7.36
High NL	23.00	6.67	18.50	8.35	22.75	7.90
			With advance organizers			
	Mean	SD	Mean	SD	Mean	SD
Low NL	25.67	6.83	23.89	6.64	18.75	8.28
Med. NL	24.40	5.83	26.25	6.24	26.50	3.53
High NL	29.75	1.26	22.57	7.34	23.50	7.82

Table 2: Results of Three Way Analysis of Variance.

ANOVA				
Source	df	SS	F-Test	P Value
Advance Organizers (AO)	1	7.91	.18	.674
Nonlinearity (NL)	2	45.54	.51	.600
Self-regulated Learning (SRL)	2	106.15	1.19	.307
AO * NL	2	270.75	3.05	.052
AO * SRL	2	29.51	.33	.718
NL * SRL	4	429.19	2.42	.054
AO * NL * SRL	4	48.89	.27	.893
Error	101	4484.61		
Total	119	5422.55		

While the results of the study showed no significant main effects or interactions, there were two near significant interactions; between nonlinearity and advance organizers ($p = 0.052$) and between nonlinearity and self-regulated learning ($p = 0.054$).

Discussion

These results strongly suggest that highly self-regulating learners learn poorly in mostly linear web based hypermedia learning environments, where they have very few choices, while medium self-regulating learners learn poorly in highly nonlinear environments where they are given too many choices. The results also strongly suggest that advance organizers are more effective in highly nonlinear web based hypermedia learning environments than in mostly linear environments. This theory is supported by previous research and should form the basis for further studies.

The practical significance of this study is limited by the lack of statistically significant results. While no concrete conclusions can be drawn, the results do support further investigation into the possibility of differential effects of nonlinearity and advance organizers for learners with different levels of self-regulation. If future studies confirm the findings then certain practical recommendations can be made. Web based hypermedia learning environments designed for students with high levels of self-regulation should offer the learners more choice than can be found in a mostly linear environment. Students who possess the ability to actively monitor and control their learning will benefit from the ability to organize and structure their instruction offered in more nonlinear environments. Medium self-regulated learners function less well in very nonlinear instructional environments than they do in more structured environments. Therefore, if the learner's level of self-regulation is known, the learning environment can be tailored to meet their needs. The use of instructional strategies can also be adjusted depending on the learning environment. In a moderate to highly nonlinear web based hypermedia environment, the designer might consider adding advance organizers to help the learners activate prior knowledge and organize the information presented. In a more linear environment, advance organizers seem to have no beneficial effects, possibly even negative effects, and should therefore not be used.

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Marist College, the Franklin Delano Roosevelt Presidential Library and Museum, and the IBM Corporation: A Showcase of Collaboration in the Development of a Digital Library

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Abstract: Marist College entered into partnership with its faculty, students, the IBM Corporation, and the Franklin Delano Roosevelt Presidential Library to develop the library of the 21st century. This long-term project includes developing multimedia products that enhance learning about the era of Franklin and Eleanor Roosevelt. These products require building rich digital library content consisting of primary documents, pictures, videos and audios from the FDR Library and storing them as reusable multimedia objects. The products use new digital library tools for organizing, indexing, watermarking, and making materials searchable. Metadata is gathered and stored and copyrights managed.

Three products, currently in development, will be integrated and used in custom-designed learning modules for college and high school history classrooms to demonstrate how thematic overviews can be developed from large reservoirs of properly stored digital information. The learning modules will be assessed and the technology and methodologies made available to others.

1. Background

Marist College set out to capitalize on the one dominant strength it has in terms of its technology infrastructure -- an integrated network serving all members of the Marist community and high speed Internet access. On this infrastructure, a digital library is being developed in collaboration with the IBM Corporation that includes the Franklin Delano Roosevelt Presidential Library; an example of an educational institution, a federal organization and industry working together to preserve and distribute the history of an era.

2. Marist-IBM-FDR Library Joint Study Team Project Folder

A comprehensive project folder is being maintained by the Marist-IBM-FDR Library Joint Study development team to enable the sharing of the collaborative process with others interested in similar projects. The team includes: the Marist College Dean of Humanities, Library Director, Director of Academic Computing, Director of Technology & Systems, Assistant Professor of History, Academic Computing Student Artist and Student Technical Consultant, FDR Library Education Specialist, IBM Global Services Consultant and Network Computing Consultant. The team reports to the Executive Vice President, Marist College. When the project folder was begun, Marist had already been involved in collaborative work with the FDR Library. Since 1994 Marist College has housed and maintained the FDR Presidential Library and Museum World Wide Web site through the Academic Computing department and its student consultants. The Marist College American History capping class, normally taught on-site at the FDR Library where primary documents are available for research, will be the initial test group for the project.

Three products, currently in development, were identified for integration into custom-designed learning modules. These are the President's Secretary's File: Franklin Delano Roosevelt; Views of FDR -- A Compendium of Research Archived from the World Wide Web; and Just for Scholars: A Research Tool. The learning modules demonstrate how any number of thematic overviews can be developed from a large reservoir of information.

3. Objective

The objective of the Marist-IBM-FDR Library project is to create a unique learning delivery mechanism and system, offering the teacher and student of history and government (and by extension, many other academic fields) the opportunity to study primary sources and materials hitherto available only to a small group of scholars [Wermuth 1998]. The primary archives for this project will be the digitized Roosevelt Confidential Office files, an electronic archive of over 150,000 pages of primary documents available only at the FDR Library in Hyde Park, New York. Other archives, some of which are completed, will be used to supplement and enhance the materials contained in the Roosevelt Confidential Office files. These include the Franklin and Eleanor Roosevelt Electronic Archives, available only through the Marist College Academic intranet. This site consists of over 50,000 pages of documents, photos, and oral histories downloaded from hundreds of Internet sites. It is presently being tested for classroom use in the Marist History Research Methods class. There is also a well-developed "Finding Aids" database, audio (over 100 Roosevelt speeches), video, and picture (2,000 photos) databases available for the project.

The kinds of questions that the student of history should be able to pursue in the envisioned environment include, "What documents did Franklin Roosevelt keep locked up in his White House office safe during the Great Depression and World War II?" "What correspondence was so secret, so confidential, so private that he kept it separate from his other presidential files, kept it close by in his presidential office, kept it safe under the watchful care of his private secretary, Grace Tully?" The 150,000 page collection contained in the 196 boxes from the President's Secretary's files is the most sought out material in the 17,000,000 pages archived at the FDR Library. And now, for the first time ever, this landmark body of historical evidence will be available on-line. Perhaps even more importantly, it will be fully text searchable, authenticated by watermark and downloadable at anytime and anywhere in the world.

We know first hand the power of this environment. The development of the "Finding Aids" database that is used by scholars to search on-line for the physical box and folder of materials housed at the FDR Library has clearly demonstrated the new information that is added to scholarly research. For example, prior to on-line full search capability, a scholar looking for information on Fala, the dog, would go to the Fala box. Now these scholars can conduct an on-line query for Fala and not only find a list of the contents of the Fala box, but also a list of every other file containing information on Fala. Previously, scholars would not think to look in the Pearl Harbor folder, for instance, for Fala, even though there might be an interesting reference in this folder.

The finding aides Database is available from the FDR Library website housed at Marist College. It can be used by going to Marist Country (http://www.academic.marist.edu) and selecting FDR Library Finding Aids.

4. Development Strategy

A storyboard will be created from the collaboration of the team with other colleges and universities as well as history teachers of high school grades nine to twelve. The project will extend over five years and includes continuous feedback from focus groups. Digitizing of the materials alone is anticipated to take two years with student interns.

Power Teams will be established to develop the learning modules. A *Power Team* is a collaborative team consisting of one or more faculty members, students from the faculty member's discipline, technical consultants and artists from Academic Computing and other people from outside Marist College as needed. These may include people from the FDR Library, IBM, high school teachers and students, and other college faculty members and students.

The project folder will guide Marist through other similar implementations as well as show others how to effectively use materials stored in a digital library. A *Center for Excellence* will be created that will enable

Marist faculty and students to show others how to collaborate in creating learning modules based on themes from materials stored in digital libraries. Templates developed will also be sold to those who wish to develop their own learning modules. A development team in the *Center* will develop learning modules at a fee for those without the expertise to do so themselves and Marist *Power Teams* will offer workshops and seminars to those interested in pursuing digital library development. Fees will be established for using Marist digital library technology and for storing other collections and related multimedia objects in the library. It is envisioned that the *Center for Excellence* will provide the revenue streams necessary to expand development of the Marist College Digital Library and other important archives in the New York Hudson Valley.

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Historical and Current Attitudes Toward and Uses of Educational Technology

A WORK IN PROGRESS

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Abstract: Three surveys are being used to ascertain the attitudes, beliefs, and preparation of in-service teachers, pre-service teachers, and student teachers regarding the uses and integration of technology into the classroom and curriculum in Elementary, Middle and High Schools in four school districts in San Antonio. The results will be compared with data gathered over the past six years as reported by the pre-service teachers in the teacher certification program at St. Mary's University and with research regarding national trends. The questions to be answered is "Are teachers better prepared to use and really implementing and integrating the uses of technology in everyday classrooms?"

1. Background

In 1992, the San Antonio, Texas consortium of institutions of higher education, local school districts, and businesses known as CEDE, Center for Educational Development and Excellence, was formed to meet the State initiative to infuse technology into teacher pre-service education and in-service training. The Texas Education Agency funded the Center with $1.9 million the first year, with the funds to be used to provide institutions of higher education and local partner schools the technological equipment and connections to begin the project. Subsequent years were funded at decreasing amounts with the intent of having the institutions of higher education and school districts institutionalize continued funding. This further funding was for training of teachers and staff of the local schools and faculty and teacher certification students in institutions of higher education.

The Education Department of St. Mary's University received $284,096 the first year, set up a computer lab/classroom, equipped all professors, and assigned the teaching of technological components to various courses in the degree plan for teacher certification students. Partnerships were formed between the University and three near-by schools - one elementary, one middle school, and one high school - which form a feeder system so that students could be followed for longitudinal information regarding changes in integration and use of technology and attitudes of teachers and students regarding such. Workshops were designed to train in-service teachers. Stipends were paid to those who participated and showed willingness to attempt integration of technology into their classroom curriculum and practices. Training for St. Mary's faculty was held and new professional growth plans were developed to reflect the University's commitment to the project. Courses were redesigned with emphasis on the use of many types of technology to fulfill syllabi requirements.

A national mandate by President Clinton in 1996 stated that every young person must be technologically literate by the 21st century. To meet this challenge, Texas has adopted standards to assure the development of technologically literate individuals who possess the knowledge and the skills to solve problems, make decisions, and be lifelong learners in a society increasingly dependent on rapidly changing technologies. The Texas Essential Knowledge and Skills (TEKS) curriculum components were adopted by the State Board of Education in 1997. They consist of basic understandings, knowledge and skills, as well as performance objectives required of K-12 students and, for the first time, have large sections devoted to technology of all types for all grade levels. Teachers are expected to integrate

the TEKS into the curriculum during the 1998-1999 school year and will be held accountable for student performance on the Texas Assessment of Academic Skills (TAAS), the standardized test used to evaluate student achievement and qualify students for graduation from high school. School districts, schools, and personnel are reviewing the current practices and developing methods to integrate and assess instruction in all areas of technology included in the K-12th grades TEKS with effectiveness of the programs primarily being measured by evaluation of student outcomes.

To meet the demands of both the Presidential mandate and the Texas Education Agency, schools must have teachers who understand and are comfortable with the uses and integration of technology in their curriculum. Finding these teachers can be very difficult, if not impossible in some areas. Trotter [Trotter 1997] cites a study done by Becker which found that only 5% of teachers using computers were "exemplary" in their use. These teachers were able to use computers as a tool for teaching. However, observation has found that the majority of teachers still instruct in the traditional manner even when computers are supplied to the classroom. Research reported in Blueprints [Blueprints 1998] shows that pre-service teachers and in-service teachers must be trained in a manner that is sustained and supported long enough for effectiveness and comfort to develop. Ideally, this training should happen before they become full time teachers if technology integration and use is to become a part of the classroom on a consistent basis. Pre-service teachers often are not exposed to the uses of any technology in the school classrooms as they observe and do field experience. Therefore, they do not understand the emphasis on and importance of getting trained before they enter the teaching work force. "We teach as we were taught, therefore, teachers rarely see examples of technological integration into the curriculum after which they can model their own teaching" [Davenport, 1995]. University professors have not been trained to model the uses and integration of technology in their teaching style, so it is difficult for students to imagine the uses of such things as hypercard, multimedia presentations, interactive video, and so on. Beaver [Beaver 1990] stated that there is a void in the training of teacher education faculty and this void is passed on to their undergraduate students.

Funding for technology is difficult to find for private institutions of higher education and economically challenged school districts, and technology is changing at an increasingly rapid pace so that upgrading and/or keeping up has become almost impossible on a district-wide or even school-wide basis. Labs are often obsolete before they are even finished and teacher training lags behind for keeping up with ever-changing applications. Schools lack connection to the Internet and the information highway is inaccessible to many, if not most, students. Without the equipment and software that are appropriate for use in the classrooms, teachers cannot use and integrate technology into their daily lessons [Davenport, 1995].

2. The Study

Three surveys were developed to ascertain the attitudes, beliefs, and preparation of in-service teachers, pre-service teachers, and student teachers. The sample population surveyed included: 1) all teacher certification students, elementary and secondary, enrolled in education courses. These were University juniors, seniors and post-baccalaureate students; 2) all student teachers enrolled in either Elementary or Secondary Classroom Management; 3) in-service elementary and secondary teachers in four school districts in San Antonio.

Results of these surveys were compared with data gathered over the past six years regarding the uses, integration, training and attitudes regarding use of technology as reported by the pre-service teachers in the teacher certification program at St. Mary's University. Research regarding national trends was also compared to the results of the St. Mary's and San Antonio data.

Quantitative data such as group means were based upon a four point Likert scale to measure responses between groups. A four-point scale was chosen to force respondents to either agree or disagree with each survey statement. The mean and standard deviation for each statement was used to determine if significant differences existed between the groups. An analysis of covariance was calculated.

3. Results

Preliminary results show that very little has actually changed in the attitudes of teachers toward the uses of technology in the classroom. The computer is still viewed as the curriculum rather than as a tool for teaching the curriculum to students. There is still resistance and fear in the integration of anything new into the classroom and teachers do not recognize the usefulness or necessity of using technology for teaching and learning. Final results will be available by conference presentation date.

Survey Documents used for this research appear in Appendix A.

4. REFERENCES

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[Blueprints 1998] Project 2061 (1998). Blueprints for reform: materials and technology. http://project2061.aaas.org.

[Trotter 1997] Trotter, A. (1997). Taking technology's measure. Education Week, XVII (11) 6-11.

Appendix A

TEACHER SURVEY

Use the following four point Likert scale to state your perceptions of technology.

4 - Strongly Agree; 3 - Agree; 2 - Disagree; 1 - Strongly Disagree

I can:

1. Launch programs: start, exit, create, name, and save files

   4 3 2 1

2. Use input devices: mouse, keyboard, disc drive, modem, recorder, and scanner

   4 3 2 1

3. Use design principles: fonts, color, white space, and graphics

   4 3 2 1

4. Delineate and make necessary adjustments regarding compatibility issues: digital files, formats, and cross platform connectivity

   4 3 2 1

5. Teach the proper keyboarding techniques and demonstrate appropriate speed

4 3 2 1

6. Use programs that demonstrate the association among visuals, spoken words, and written words: pictures, graphics, animation, and video

4 3 2 1

7. Teach appropriate electronic search strategies (including keyword and Boolean)

4 3 2 1

8. Create technology assessment tools to monitor progress of projects: checklists, timelines, and rubrics

4 3 2 1

9. Plan, create, and edit a document with a word processor using readable fonts, alignment, page setup, tabs and ruler settings

4 3 2 1

10. Create and edit, spreadsheets using all data types, formulas, functions, and chart information

4 3 2 1

11. Plan, create, and edit database by defining fields, entering data, and designing layouts appropriate for reporting

4 3 2 1

12. Use interactive virtual environments such as virtual reality or simulations

4 3 2 1

13. Use telecommunication tools for publishing such as Internet browsers, video conferencing or distance learning

4 3 2 1

14. Use programs such as:

Desktop publishing

4 3 2 1

Digital graphics and animation

4 3 2 1

Multimedia

4 3 2 1

Video technology

4 3 2 1

Web mastery

4 3 2 1

15. Use other electronic devices:

Camcorders

4 3 2 1

VCR

4 3 2 1

Tape recorders/players

4 3 2 1

Programmable or remote control toys

4 3 2 1

Walkie-talkies/cellular phones

4 3 2 1

Telephone and voice messaging

4 3 2 1

16. Effectively manage files

4 3 2 1

17. Use word processing to develop, store, retrieve, edit, format and publish error free written products

4 3 2 1

18. Write effectively using research and retrieval from electronic reference materials and incorporate graphics appropriately to enhance written product

4 3 2 1

19. Use e-mail

4 3 2 1

20. Can access, organize, and use information in various formats and from various sources for problem solving, decision making, and persuasive presentations

4 3 2 1

21. Collect, analyze and report statistical data

4 3 2 1

22. Enjoy surfing the WEB

4 3 2 1

23. Use WEB to enhance course content

4 3 2 1

24. Finish work faster when I use a computer

4 3 2 1

25. Learn more from books than from a computer

4 3 2 1

26. Have students learn more from books than from a computer

4 3 2 1

27. Comfortable doing my own trouble shooting

4 3 2 1

28. Spend many hours surfing the WEB

4 3 2 1

29. Spend as little time as possible surfing the WEB

4 3 2 1

30. Feel comfortable asking for help when I need assistance

4 3 2 1

31. Use a computer in my class to make me a better teacher

4 3 2 1

32. Use computers to enhance remedial instruction

4 3 2 1

33. Use computers to reduce many routine duties

4 3 2 1

34. Electronic mail (e-mail) is an effective means of disseminating class information and assignments

4 3 2 1

35. More courses should use e-mail to disseminate class information and assignments

4 3 2 1

36. E-mail provides better access to students

4 3 2 1

37. The use of the WEB activities encourages greater motivation and creativity

4 3 2 1

38. The use of the WEB encourages greater student involvement

4 3 2 1

39. The use of technology helps students to learn more

4 3 2 1

40. Computers are changing the world too rapidly

4 3 2 1

41. Computers in my room would help make me a better teacher.

4 3 2 1

STUDENT TEACHER TECHNOLOGY SURVEY

Circle the correct response:

1. During student teaching did you participate in any computer instruction with your students?

YES NO

2. Did this instruction take place in a:

a. computer lab

YES NO

b. classroom

YES NO

3. During student teaching I observed, or used the following types of technology for instruction:

a. Photocopying/transparency	YES	NO
b. Overhead projector	YES	NO
c. Video camera	YES	NO
d. Videocassette recorder	YES	NO
e. Sound-filmstrip projector	YES	NO
f. Laser disc player	YES	NO
g. Compact disc player	YES	NO
h. Use of software	YES	NO
i. Computer projection	YES	NO
j. Equipment maintenance	YES	NO

k. Auxiliary camera YES NO

l. Multi-media presentation YES NO

4. Were these an integral section of content instruction? YES NO

Use the following four point Likert scale to state your perceptions of technology

4 - Strongly Agree; 3 - Agree; 2 - Disagree; 1 - Strongly Disagree

1. Technology provides a means of using class time effectively to meet the objectives of the course

   4 3 2 1

2. Technology provides a means of using course examples and illustration effectively

   4 3 2 1

3. Technology provides a means of presenting well organized presentations

   4 3 2 1

4. I am comfortable using technology

   4 3 2 1

5. I am comfortable using

   a. Photocopies/transparencies

   4 3 2 1

   b. Overhead projector

   4 3 2 1

   c. Video camera

   4 3 2 1

   d. Video cassette recorder

   4 3 2 1

   e. Sound-filmstrip projector

   4 3 2 1

   f. Laser disc player

   4 3 2 1

   g. Compact disc player

   4 3 2 1

   h. Software

4 3 2 1

i. Computer projection

4 3 2 1

j. Computer maintenance

4 3 2 1

k. Auxiliary camera

4 3 2 1

Multi-media presentation

4 3 2 1

6. Students are comfortable using technology

4 3 2 1

7. I am comfortable interpreting computer data

4 3 2 1

8. Students are comfortable interpreting computer data

4 3 2 1

9. I find working on a computer is boring

4 3 2 1

10. Students find working on a computer is boring

4 3 2 1

11. Working on a computer makes me feel frustrated

4 3 2 1

12. Working on a computer encourages my feelings of aggression and hostility toward the machine

4 3 2 1

13. Implementing computer technology in a classroom is a waste of time

4 3 2 1

14. Working on a computer develops feelings of isolation and lack of personal control

4 3 2 1

15. I find technology implementation stimulating

4 3 2 1

16. Currently and in the future technology will play an important role in everyone's life

4 3 2 1

17. E-mail was used to share information and assignments in the class

4 3 2 1

18. E-mail enhances instruction

4 3 2 1

19. E-mail provides better access to students in a class

4 3 2 1

20. E-mail provides better access to the teacher in a class

4 3 2 1

21. E-mail use increases student motivation

4 3 2 1

22. E-mail increases student interest in expanding their knowledge

4 3 2 1

23. The use of E-mail encourages student involvement in learning

4 3 2 1

24. The use of E-mail provides better learning experiences

4 3 2 1

25. Enjoy surfing the WEB

4 3 2 1

26. Use WEB to enhance course content

4 3 2 1

27. Finish work faster when I use a computer

4 3 2 1

28. Learn more from books than from a computer

4 3 2 1

29. Student learn more from books than from a computer

4 3 2 1

30. Comfortable doing my own trouble shooting

4 3 2 1

31. Spend many hours surfing the WEB

4 3 2 1

32. Spend as little time as possible surfing the WEB

4 3 2 1

33. Use a computer in my class to make me a better teacher

4 3 2 1

34. Use computers to enhance remedial instruction

4 3 2 1

35. Use computers to reduce many routine duties

4 3 2 1

36. Electronic mail (e-mail) is an effective means of disseminating class information and assignments

4 3 2 1

37. More courses should use E-mail to disseminate class information and assignments

4 3 2 1

38. E-mail provides better access to students

4 3 2 1

39. The use of WEB activities encourages greater motivation and creativity

4 3 2 1

40. The use of the WEB encourages greater student involvement

4 3 2 1

41. The use of technology helps students learn more

4 3 2 1

42. Computers are changing the world too rapidly

4 3 2 1

43. Computers in my room would help make me a better teacher

4 3 2 1

TECHNOLOGY SURVEY FOR ALL EDUCATION STUDENTS

Use the following four point Likert scale to choose your perception of your current competency:

4 - Strongly Agree; 3 - Agree; 2 - Disagree; 1 - Strongly Disagree

1. Competent in using:

a. Photocopying/transparency

4 3 2 1

b. Overhead projector

4 3 2 1

c. Video camera

4 3 2 1

d. Video cassette recorder

4 3 2 1

e. Sound-filmstrip projector (Dukane)

4 3 2 1

f. Laser disc player

4 3 2 1

g. Compact disc player

4 3 2 1

h. Use of software

4 3 2 1

i. Computer projection

4 3 2 1

j. Equipment maintenance

4 3 2 1

k. Auxiliary camera

4 3 2 1

l. Multi-media

4 3 2 1

2. Working with technology makes me uncomfortable

4 3 2 1

3. Interpreting computer data is difficult

4 3 2 1

4. Computer work is boring

4 3 2 1

5. Technology work is frustrating

4 3 2 1

6. Computer work is frustrating

4 3 2 1

7. Working with technology encourages feelings of aggression and hostility toward the machines

4 3 2 1

8. Working with computers encourages feelings of aggression and hostility toward the machines

4 3 2 1

9. Working with technology encourages feelings of isolation and lack of personal control

4 3 2 1

10. Working with computers encourages feelings of isolation and lack of personal control

4 3 2 1

11. Working with technology is stimulating

4 3 2 1

12. Working with computers is stimulating

4 3 2 1

13. Work with computers can be embedded within course content

4 3 2 1

14. Work with technology can be embedded within course content

4 3 2 1

15. Work with computers can enhance course content delivery

4 3 2 1

16. Work with technology can enhance course content delivery

4 3 2 1

17. Technology implementation will play an important role in my career choice

4 3 2 1

18. Computer implementation will play an important role in my career choice

4 3 2 1

19. Gaining competency in the use of technology in education is difficult

4 3 2 1

20. Gaining competency in the use of computers in education is difficult

4 3 2 1

21. I enjoy surfing the WEB

4 3 2 1

22. I use the WEB to enhance course content

4 3 2 1

23. Reread 20, 21 and 22 and in a short statement tell why you answered as you did.

The Virtual Workshop Companion: A Web Interface for Online Labs

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Abstract: The Virtual Workshop is a Web-based set of modules on high performance computing. One interesting new technique we have been refining over the past year is to securely issue lab exercise commands directly through the web page. This paper describes the interface itself, how this technique is incorporated into online lab exercises, participant evaluation, and future plans.

Introduction

Cornell Theory Center (CTC) began offering asynchronous learning over the Web in 1995 with its first offering of the Virtual Workshop. Since then, we have served nearly 900 workshop participants, expanded the number of topics covered, and introduced new Web-based features to enhance the learning environment. One exciting new technique is presented here; called the Virtual Workshop Companion, it allows execution of lab exercise commands via a secure web interface.

CTC Education and the Virtual Workshop

CTC has been developing and delivering education in high performance computing to researchers, faculty and students, for over ten years. CTC education programs have included on-site workshops in high performance computing and discipline-specific computing software and techniques, special programs for K-12 and undergraduates, and education accounts for college courses. The course materials are based on the CTC's IBM RS/6000 SP scalable parallel computer, and all lab exercises are run on this machine.

Web-based materials are well suited to our education environment, which requires frequent material updates to keep pace with rapidly changing technology. We migrated our extensive set of workshop lectures, on-line tutorials, and lab exercises into dual-purpose web-based modules, which could serve as both live lectures and on-line self-paced materials.

In 1995 we offered our first remote workshop via the World Wide Web. To date, we have conducted nine Virtual Workshops for nearly 900 participants. These workshops covered different sets of six topics comprised of forty modules: Parallel Programming, Message Passing Interface (MPI), High Performance Fortran (HPF), Parallel Virtual Machine (PVM), Performance, and Scientific Visualization.

A goal in the Virtual Workshop evolution is experimentation with techniques intended to provide more interaction, as well as options for participants with different learning styles. Features we have added include

- A Glossary, written in JavaScript. Clicking on a glossary term brings up the glossary in a new window, positioned at the selected term.
- Interactive quizzes, written with CGI Scripts. The quizzes are multiple choice forms. Submitting the quiz form automatically grades the quiz and returns a list of questions that were answered incorrectly, with optional explanation.

- Personalized navigation with Netscape Frames. Frames allow workshop participants to move through material in a way that best suits their learning style and needs.
- Animations using Gifmerge, MPEG, or QuickTime. Participants like animations that enhance the text description of the topic.
- Audio-tagged foils. Files converted from a videotaped lecture at CTC were 'tagged' to the foil used in the presentation and inserted in the module.
- MOO/Chat - Discussion Forums. A forum was provided to promote discussion among the participants as well as with the CTC staff.

Mehringer discussed these techniques at WebNet 97 in a talk titled "Techniques for Enhancing Web-Based Education".

A more comprehensive total learning environment has been achieved by refining the Virtual Workshop Companion, which provides the ability to edit, compile, set run-time parameters such as number of processors, and submit a program, all without leaving the Web browser. The Virtual Workshop Companion utilizes a combination of Java programs and Perl scripts. The Java programs handle the front end user interface, while the Perl scripts interact with AFS Kerberos authentication to provide the required security for the users.

The Virtual Workshop Companion: How it Works

In order to develop the Virtual Workshop Companion, we needed a mechanism for users to type commands as they are instructed, have the commands execute on the IBM SP, and display the results of these commands in the web page. To accomplish this we have developed the Secure Web (Sweb) package for Web-based authentication. This will guarantee that only authorized users of the VW can obtain access to the IBM SP or other secure resources at CTC.

Sweb uses Java clients that connect to a port on an Sweb server that resides in a secure machine room. This server does not allow users to telnet into it directly and has a trusted relationship with the IBM SP. This means agents running as a user on this server can rsh commands to the IBM SP nodes. Users communicate with the Sweb server from their web browser and commands are issued to the IBM SP from the Sweb server for them [Fig. 1]. When a client connects, the server creates a user agent that communicates with the client on a new available network port. This agent will not perform any user tasks or commands until the user has successfully authenticated him/herself.

The Java client has a login box in which users enter their username and password. The client encrypts this information and sends it to the listening agent. Once users have successfully authenticated themselves, tasks or commands generated by interaction with the VW Web pages can be run on the Sweb server or on the IBM SP via rsh. The results of these tasks and commands are returned to the waiting client in the form of text, numeric, or image data. The network connection between the client and its associated agent is persistent; only the valid Web user can send commands to the authenticated Sweb agent.

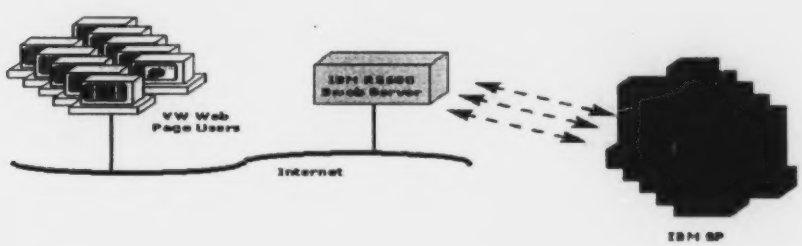

Figure 1: Sweb Server Communication

The Sweb user agent code that runs on the Sweb server is written in Perl. All commands a user attempts are checked and "untainted" [Wall & Schwartz 1991] for security purposes. This code issues an AFS "klog command" on the Sweb server with the user provided username and password to acquire an AFS kerberos token. Once a token is successfully obtained the Perl agent uses the UNIX setuid capability to become a process running as that user. At this point all commands issued by the user's agent are run for the user, as the user.

In addition to the login box, we have written additional Java applets that are layered on top of the Sweb Java class library. The applets implement a simple file browser and editor, a restricted Unix shell, and command boxes.

Sweb provides the flexibility necessary for other applications that require access to secure resources. An example is Llava, a tool that allows remote resource and queue monitoring of the IBM SP from a web browser. Sweb allows us to ensure that only people with accounts on the CTC SP system can access this information. Another application is remote execution of IBM Data Explorer modules that produce jpeg images that can be displayed using the remote users web browser.

The Virtual Workshop Companion: Design Implementation

Prior to development of the Virtual Workshop Companion, we had a set of forty online lab exercises, each in the format of a simple html page, organized in a standard format. The labs were written to practice and reinforce concepts presented in an instruction module. The labs consist of background information followed by specific tasks. To work through a lab exercise, the workshop participant would bring up the lab exercise instructions in the browser, open a telnet window to the IBM SP where the exercises are based, and go between the browser and telnet window to read instructions, then edit or issue commands.

This method has two obvious problems. The first is that the user must constantly shift their attention between two windows. There might not be room on the screen to read both windows at the same time, making it necessary to either copy down commands or print out the instructions. The second problem stems from the exercises being based on CTC's IBM SP, which may not be the participant's usual computing platform. Many people who participate in the Virtual Workshop will not ultimately do their computing on the IBM SP, and so learning the specifics of the operating system, file system, and editor only serve to take attention away from learning the topic at hand.

The Virtual Workshop Companion addresses both problems. Since it enables commands to be issued directly from the web page, commands and instructions can all appear in one window. It also allows us the flexibility to either provide, or automatically execute, commands that are not germane to the subject, for example, knowing the exact location from which the lab files are copied.

At this stage we believe we need to offer exercises in two ways, incorporating the Virtual Workshop Companion, and using the separate telnet window. The latter is necessary until we feel most people have Java-capable browsers, and may be preferred by those who know UNIX. This fact spawns another requirement; to find a way to offer both methods without the overhead of updating and maintaining two copies of each lab exercise.

The first production use of the Virtual Workshop Companion in 1997 was a technical success. It incorporated secure authentication and the lab exercises could be executed solely through a web page interface. However, the two problems described above were not addressed: the lab directions and web interface were still in two separate windows, and it was not easy to control how much the user needed to know about site-specifics. It was also difficult to modify additional labs to use the Virtual Workshop Companion.

Given technical success, we then began work on improving the implementation design. As discussed in the previous section, separate, task-specific applets were written to provide the functions of simple file browser and editor, a restricted Unix shell, and command boxes. We took those modular applets and incorporated them directly into the lab instruction page. After trying several models, we decided on the following design:

- Each lab begins with a short page that lets the user decide whether to do the lab using a telnet window or the Virtual Workshop Companion. The page includes some information to help make that decision, such as a description of the choices, browser requirements, and platforms that have been tested.
- Once the user chooses the Virtual Workshop Companion, the lab page appears as two frames, as shown [Fig. 2]. The top frame contains the lab instructions. The bottom frame includes buttons to login (authenticate), and copy the lab files. This frame has two main working boxes; a restricted shell from which all lab commands can be executed, and a file list, from which the user can select and edit files. In addition to these basic functions, there are also buttons to view a log of the working session,

get help, update the list of files, and delete the files and working directory when finished. These two frames provide all the functionality needed to complete the lab exercise.

We believe this arrangement best satisfies the requirements. The Virtual Workshop Companion elements look the same in all labs, providing a familiar environment. It is easy to incorporate into new labs. It is flexible enough to be used with all labs. There is only one copy of the lab instructions for using either telnet or the Virtual Workshop Companion.

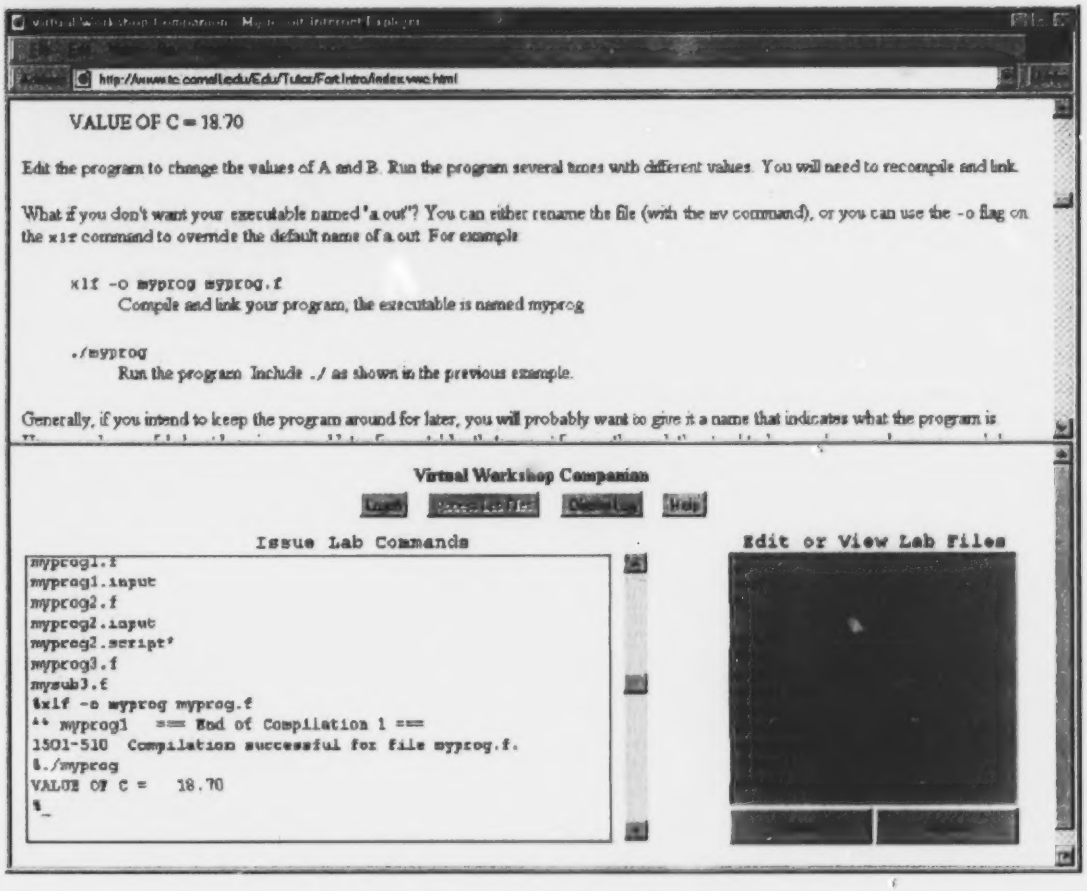
VALUE OF C = 18.70
Edit the program to change the values of A and B. Run the program several times with different values. You will need to recompile and link.
What if you don't want your executable named 'a.out'? You can either rename the file (with the mv command), or you can use the -o flag on the xlf command to override the default name of a.out. For example
xlf -o myprog myprog.f
Compile and link your program, the executable is named myprog
./myprog
Run the program. Include ./ as shown in the previous example.
Generally, if you intend to keep the program around for later, you will probably want to give it a name that indicates what the program is
Virtual Workshop Companion
Help
Issue Lab Commands
Edit or View Lab Files
myprog1.f
myprog1.input
myprog2.f
myprog2.input
myprog2.script*
myprog3.f
mysub3.f
%xlf -o myprog myprog.f
** myprog1 === End of Compilation 1 ===
1501-510 Compilation successful for file myprog.f.
%./myprog
VALUE OF C = 18.70
%

Figure 2: The Virtual Workshop Companion

Evaluation Results

We ran a Virtual Workshop using the Virtual Workshop Companion in Spring 98. The workshop had lab exercises available in two formats: with the lab instructions carried out in a separate telnet window, or by using the Virtual Workshop Companion. We asked the participants which format they preferred and why. Unfortunately, this group was already UNIX and telnet literate, preferred the interfaces they already knew, and did not pursue use of the Virtual Workshop Companion. We are looking forward to gathering more results during Virtual Workshops planned for Summer and Fall. If a participant uses the Virtual Workshop Companion, we will ask for: a general rating, whether they felt they learned more or less by using the Companion, as compared to a telnet window, ease of use, speed of use, clarity of instructions, features they especially liked, suggestions for improvement, and comments,

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Future Plans

Future plans will largely be determined by the feedback we receive during future Virtual Workshops, as well as our experiences implementing the Companion into our many labs. Possibilities include redesign of the user interface, replacing the restricted shell with a full shell, an interface that will allow for different levels of difficulty, and/or built-in feedback.

We will continue to explore new techniques to provide an interactive and engaging learning experience in the Virtual Workshop.

Conclusions

Web-based education is an effective means for CTC to leverage its education efforts to both local and remote audiences. We expect that adding the Virtual Workshop Companion to the existing features of the Virtual Workshop will be well received by participants, especially as they are encouraged to focus on the primary topic rather than the details of running on a particular machine. We will certainly learn from our experiences using the Virtual Workshop Companion in future Virtual Workshops, and expect to make further refinements based on feedback from those Virtual Workshop participants.

Summary of URLs

Cornell Theory Center
http://www.tc.cornell.edu/
CTC education
http://www.tc.cornell.edu/Edu/
Virtual Workshop
http://www.tc.cornell.edu/Edu/VW/
Llava
http://www.tc.cornell.edu/UserDoc/SP/Llava_info.html

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Web-Based Introductory Astronomy as a Case Study: Issues for Faculty and Administrators

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Abstract The Web has been introduced into an introductory astronomy course for 3 semesters in a graduated fashion: from an adjunct to an option in a lecture class to a stand-alone course. Various functional and pedagogical issues have arisen as the online nature of the course has progressed. On the one hand there is a mismatch among student, faculty and administrator rationale, goals and expectations. On the other, there is much promise of meeting specific learning styles and needs. This is a two-year evaluative study; late results will be presented.

In the fall of 1997 we offered a one - semester introductory astronomy course in two formats to a class of 90 students. Students could choose either a multimedia - based lecture course that met 3 hours/week in a classroom setting, or they could elect to take the course on line. Approximately half chose to take the course in class, and one-half chose to take the course on line. In the spring of 1998 we offered the same course in a web-only format to 50 students. Various functional and pedagogical issues have arisen as the online nature of the course has progressed.

Reasons for offering online courses vary. Some faculty, including ourselves, see the web as a dominant teaching and learning tool in the near future, with a degree of interactivity and possibility of individual guided inquiry which is not possible within conventional settings. Administrators may regard the offering of web courses as cost cutting strategies in a time of escalating higher education costs. Legislators are concerned with possible financial savings and may be responding to calls from their constituents who wish higher education but cannot attend a local university or college. Students may exert upwards pressure to increase online course offerings so that their educational goals may be met at the same time as their family and career goals.

Preparation time can vary from little (export lecture notes as html files for an 'electronic lecture notes' course) to many hundreds of hours (for those viewing an online course as a supplement to a textbook with explanatory material, abundant use of graphics and interactivity, etc.). There might be a new vocabulary to differentiate between these approaches, and there hopefully will be data, which can compare the learning effectiveness of these two distinct styles. The amount of time (up-front time) required to implement the second approach is daunting, and will dissuade all but the most idealistic faulty.

Large universities or colleges who have made a substantial commitment to online course development will necessarily make a large commitment to a technical staff capable of providing assistance in solving problems which arise: networks, servers, web authoring, and more. In other settings the individual faculty will bear the burden. There is clearly a close connection between these considerations and the selection of authoring and administration tools. Pedagogical needs of faculty rather than the administrative rationale of information technologists should drive the selection of authoring tools.

It is difficult for some faculty to grasp differences in learning styles which individuals and well as groups possess. Faculty, on the average, may be more able to grasp the spoken word. Today's students, on the other hand, seem to be more visually cognizant. Does this mean that the spoken lecture should give way to the electronic lecture? Hopefully not, for the hyperlinking and interactive capabilities of the Web can accelerate

the metamorphosis of faculty from dispensers of information to mentors of students. The degree of individuality which is built into the online course is limited by faculty time, access to tools and to faculty imagination and pedagogical expertise.

Until the actual reward criteria for faculty is changed from publishing well- defined research papers to developing more effective teaching and learning strategies, individual faculty will pioneer the development of online courses because of some inner drive. These pioneers may not only be unrewarded (or minimally so) by their institution, but they could also be looked upon with suspicion by those faculty, administrators and students who do not yet comprehend the changing nature of both the marketplace and of the results of the past ten years of cognitive research. The pioneers will, we can be optimistically confident, lead by their example and be the nucleus of a growing number of faculty who will find satisfaction in revitalizing their teaching by infusing it with the web's interactive capabilities.

Online courses can be defined differently to fit different agendas. Notes ancillary to a class might be considered such a course by some. To others, a syllabus and a chat room might suffice. Security considerations might limit access to those using computers on campus, while others, perhaps working through a university Extensions Program, might wish access to anyone in the state or even the world. It is the domain of administrators to determine how students are 'counted' and who gets credit for what. Although this is a tedious detail it is important - funds from legislatures often are determined by body count.

Java and scripting languages allow interactivity at the individual student level on a scale not possible in large classes. The down side, however, is that there is a long learning curve to apply the tools necessary for complete interactivity. Fortunately, software is being developed which will allow 'the rest of us' to write cgi or java code 'behind the screen'. Tango Editor, FilemakerPro Web Companion and others already do this in a restricted manner. Others, such as Robin, a CGI editor application and a back-end engine from 1.0 Technologies Inc. will permit webmasters to develop cgi scripts offering client and server pull and push, will save form data and more.

Students have grown accustomed to talking to instructors before and after traditional classes, perhaps during class (depending on the nature and size of the class), and during a select few hours of the week (office hours). The asynchronous nature of the web has become transformed in the minds of many students into instantaneous accessibility of the instructors as well as course material. Some instructors might alleviate that problem via the nature of the course (large reading assignments with a few big term papers), and some might merely state that s/he will not accept emails. Other courses may lend themselves to posting of 'Announcements' or to using threaded discussion groups. To many students, however, personal electronic interactivity with the instructor is a huge step forward. The ability to personally communicate without the 'class embarrassment' syndrome has enabled many students to thrive in an otherwise hostile environment.

Financial assistance may be necessary to prevent only the relatively affluent from taking advantage of an online course. Without personal computers, some students will only be able to access the web course on campus, limiting their options and raising equity questions, which must be addressed in the public sector.

Analysis of learning and attitudes of web and class students in the Astronomy web course offered in the fall of 1997 is available online [Meisner, Hoffman, 1998]. 54 males and 48 males took the course, with no sharp boundary between those who were 'class' students and those who were 'web' students. Students were 'mainly' web students or 'mainly' class students, with 'bleeding' from one to the other classification. A preliminary analysis shows that there were no sharp distinctions between the two groups, perhaps a result of the 'bleeding' effect. Although 'web' students accessed the online course more often, the effect was not dramatic. Neither were their opinions on the effectiveness of the online course as a vehicle for learning astronomy and other pedagogical questions. There were likewise no sharp differences between responses by males and females in their use of another Internet functionality - email. Essentially equal percentages of males and females used email as a communication medium to the instructor, and the number of emails scaled almost precisely as well. Both groups strongly felt that the introductory astronomy course should continue to be offered with a web option, and both groups felt strongly that more courses on campus should have a web option. An analysis of students in the same course taught only online in the spring of 1998 will also be discussed, paying particular attention to changing expectations and an increase in class size.

During the Web-only semester of spring 1998, email was an important 'tutorial' tool, which mostly female students used. 20% of the students accounted for two-thirds of the email with a rate of 3-5 communications each per week. Cooperative learning among these students became the norm, with the instructor becoming a guiding mentor rather than a dispenser of information.

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EMSL's Electronic Laboratory Notebook

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Abstract: As part of our Collaboratory for Environmental and Molecular Sciences project and the Department of Energy's DOE2000 Electronic Notebook project, we have developed a WWW-based Electronic Laboratory Notebook (ELN) which provides users with a shared, interactive version of the traditional paper laboratory notebook. Entries can include text, html, links, images (files or screen captures), and dynamic data, e.g. re-scalable graphs, rotatable 3D molecules, etc. Each submission is tagged with the author's name, digital signature, date/time, and other pertinent meta-data. The notebook is easily extended to handle additional data types using Java applets, plug-ins, and "helper" applications via a simple programming interface. The ELN, consisting of a CGI-based server and digitally signed client applets, requires no client side installation. The server software is freely available from our web site. In this talk we will describe the design and features of the ELN, and give some examples of its use in research and education projects.

1. Introduction

As the world moves towards electronic data management so do scientists and educators. The paper notebook, a reliable staple of the laboratory and classroom, is becoming increasingly obsolete as the volume and complexity of the data we deal with increases. Although paper retains some advantages in portability and in the ease of entering notes, electronic notebooks also have advantages. They can reduce the amount of information that needs to be written or sketched in the first place by eliminating the need to manually transcribe data that already exists in electronic form. Further, they can have automated searching and indexing capabilities, can display multidimensional and time dependent data, and can be used by more than one person at a time, regardless of location. We have developed a WWW-based Electronic Laboratory Notebook (ELN) that provides these and other advanced capabilities. The ELN is based on a common, extensible notebook architecture we have developed in collaboration with researchers at Lawrence Berkeley National Laboratory and Oak Ridge National Laboratory through the Department of Energy's DOE2000 program.

2. Functionality

The Environmental Molecular Sciences Laboratory (EMSL) ELN presents users with a familiar chapter and page based metaphor. After logging into a notebook by typing a user name and password on a notebook's Web page the user is presented with the notebook's table of contents. Double-clicking on the name of a page opens that page in a separate window. Users can view existing notes, see who entered the note and see when it was created. Each note can contain text, hypertext, images, and a variety of domain specific data types. For example, a note could contain a comment with links to reference material, a short video of a molecular dynamics simulation, and/or a live 3D-protein structure that can be rotated and zoomed. To enter information, the user opens a text or HTML editor, starts an image capture utility, brings up a file browser, all from within the notebook interface. Each entry is added to a list as it is created and the whole collection is transferred to the server when the "Submit" button is clicked. At this point, the new information is available to everyone logged into the notebook.

The notebook can be hosted on a secure web server and use secure sockets layer (SSL) encryption to keep the data private. We are currently adding the capability to authenticate users based on their public key based identity and to allow public key based digital signatures to be attached to notebook pages, helping to make the electronic notebook a legally defensible record. Additional capabilities for searching entries, sending email notification when new notes are created, and for administering the notebook also exist.

3. Architecture

The ELN consists of a CGI-based notebook server and a Java applet, JavaScript, and HTML based client. The server authenticates users, stores new entries in flat files, and dynamically generates HTML responses for page requests, search queries, etc. HTTP cookies are used to associate a specific user with each request, allowing the server to automatically assign authorship of new entries and to grant or deny read, write, and delete privileges as defined by the administrator for each user. The client uses HTML and JavaScript for page layout. The table of contents, note submission interface, and search capability are all contained in a Java applet. Normally, applets downloaded from the WWW are not allowed to run processes on the local machine or read/write files. Our notebook client applet needs to do both to allow image capture and to upload local files respectively. Both Netscape and Microsoft provide mechanisms to let the user grant these privileges to specific applets. Our current applet implements Netscape's privilege manager system and is digitally signed so that the user can verify its origin and integrity before granting it privileges. The user-interface is written using the Swing 1.0.3 user interface components. Swing provides a much better look and feel to the applets than Java's AWT classes. However, since Swing is not yet included in Netscape's browser, the user must either load Swing locally by hand or endure additional download delays as the relatively large Swing class library is downloaded from the server.

One of the key elements of the ELN is its extensibility. Programming interfaces exist for adding new types of entries (voice annotation, equations, etc.), displaying new data types, and allowing automated entry of notes from other applications, e.g. for allowing a scientific instrument to automatically send experiment parameters to the notebook. Third parties can create editors and viewers, or integrate new data acquisition or analysis applications without having to understand the notebook communications mechanism, digital signatures, or other features. Currently the ELN comes with four editors: plain text, html, image capture, and file upload. In addition to the data types supported by the browser itself, we have integrated a 3D molecule viewer, a live XY graph for mass spectroscopy data, contour plots of 2D nuclear magnetic resonance spectra, and more. We have also demonstrated the capability to link instruments to the notebook; NMR researchers can type a simple command from within their data acquisition software to send their experiment parameters into the notebook.

4. Conclusion

Some of our most progressive users of electronic notebooks are researchers using the EMSL Nuclear Magnetic Resonance spectrometers. They maintain common notebooks to share literature references, procedures, experiment results, protein structures derived from the data and ideas for papers. Complementing remote control of the instruments and real-time conferencing tools, the ELN has allowed experiments to be conducted entirely via the Internet. Chemistry classes at Eastern Oregon University have also used our electronic notebook to keep track of assignments, experiments, and results. Overall, we currently furnish over a dozen notebooks for different groups and projects. The continuing growth in requests for new notebooks shows that the ELN can be an effective means of recording and sharing research results, supplementing or replacing traditional paper notebooks. Its WWW-based architecture makes it particularly well suited for use by distributed groups, but its multimedia capabilities, extensibility, and other capabilities also make it a reasonable alternative for individual researchers.

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A Parallel Computing Architecture for Information Processing: Visualizing, Indexing, and Mining

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Abstract: In this paper we define DaVIME (Data Visualization, Indexing and Mining Engine), a software architecture that performs data visualization, indexing and mining in an integrated environment. DaVIME presents a unified view of information to the users. When a user issues an information service request, DaVIME calls the appropriate software module to provide the requested service. One or more components may be called into action depending on the request. DaVIME is an open, extensible architecture that allows researchers and developers to add software modules incrementally.

DaVIME (Data Visualization, Indexing and Mining Engine), provides an information services architecture including data visualization, indexing and mining. The core of this research is a suite of tools to provide internet-based information services. Our design goal is to have an open, extensible architecture that provides a comprehensive and unified view of an information service for users and allows incremental development for researchers. The system is divided into four major components, the User Interface Coordinator (UIC), the Data Resource Coordinator (DRC), the Computing Resource Coordinator (CRC), and various Extensible SoftBots (ESB). An overview is given in [Fig.1].

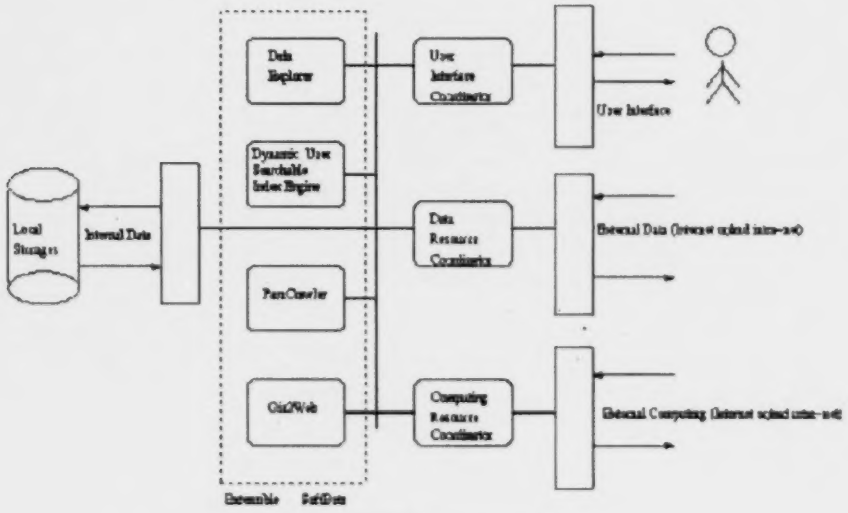

FIGURE 1. DaVIME system architecture.

Users request information services through the UIC. This module accepts, refines and then sends service requests to appropriate ESB softbots for processing. The ESB is an expandable collection of information processing modules. Current ESB modules include:

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- Document Explorer - analyzes textual information in large document collections, calculates "distances" (i.e. similarity) among documents, and presents the results visually such that related documents are linked closely [Fowler, Fowler & Williams 1997].
- Dynamic User-created Searchable Index Engine (DUSIE) - extends hierarchical indexing schemes to allow users to build personalized context-based searchable indices [Lawrence-Fowler, Williams, Fowler & Meng 1998]. Users can organize Web indices into a hierarchy of their own choice as well as add annotation to the indices [Fowler, Fowler, Williams, Palacios & Palacios 1997].
- ParaCrawler - uses a novice ranking and indexing algorithm to collect, cull, and present accurate search information from the Web [Fox 1997; Fox, Ochoa & Paredes 1996]. The search uses personalized information from users and retrieves search results in parallel [Meng & Chen submitted].
- Gis2web - allows users to access GIS data from the Web by interacting with regular GIS software such as ArcView and ArcInfo [Meng, Fowler & Rieken 1997].

The DRC handles data exchange among ESB components. The final component, CRC, provides access to any available computing resources (CPU cycles & storage) from intranets and the Internet. The CRC will register resource requests from internal DaVIME components, work with brokers, find available hosts on the network that are willing to share resources, and request services from those hosts.

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Using the Web to Study History

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In this work we present an application for the lesson of modern history.

The targets are:
- the investigation and understanding of the underlying causes of the events and their consequences
- the enhancements of abilities for information evaluation.

To reach the above, we present a multi-path exploration process to shape a *global event*. The global event has a *virtual content* consisting of directly or indirectly connected : opinions, views, facts e.t.c. Thus the history lesson resembles an investigation/research process through a dynamic procedure of selections - comparisons - adoptions/rejections.

The content can be presented and accessed either by *theme* or by *time periods* and its retieval can be adjusted in multiple ways, predefined or adapted to the dialogue evolution.

For the implementation, we have used HTML, Javascript, the BOURNE shell and working environment was the Netscape Communicator due to its conference services.

Structured Feedback Handling

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Customer Interaction Management on Commercial WWW-Sites

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Abstract: Electronic Commerce changes communication between companies and their customers. A customer friendly web site should address customer's information needs and actively help users to obtain relevant information. For information gathering that exceeds "customer self-service" it is necessary to tie customers into internal processes that direct feedback or questions to company experts. Globally collecting incoming feedback and answering it in general terms puts a company in a bad perspective. It is the quality of these services, which adds the competitive extra value to a company's web site.

This paper describes a system to help companies to deal with customer feedback in a structured way for competent and fast response. This is achieved by the "Customer Interaction Management System" that effectively supports cooperative work processes dealing with locating experts and answering feedback.

1. Introduction

"Customer Interaction on Web Systems" is basically any communication between a customer and a company over the Internet using World Wide Web technology. For a customer reasons for communication can be general information requests, specific questions, feedback to products or services or also complaints. There are two ways of communication from a customer's point of view. A customer can either interact with a system or with another human being. If a customer interacts with a system this, in many cases, is based on information that is stored in a database or a file system. A very common interaction of this type on the Internet would be a search within a Frequently Asked Questions (FAQ) archive. The second type of interaction involves people and ranges from sending a simple mail and getting a reply to initiating complex workflows within a company that involve several people.

The best way of course to deal with customer interaction on a company web site is to actually offer personal contact with internal experts to their customers. When doing this a company has to think about the consequences. How many people within the company can be involved with feedback answering? How to keep track of all feedback and questions that come in? Which is the best way of supporting experts answering feedback? Any systematic approach to dealing with customer feedback leads to "customer interaction management" which is the topic of this paper.

2. Feedback coming in via Internet/ WWW

The general field of handling customer feedback reaching a company via traditional communication methods (phone, mail, in person) is well discussed and has been developed extensively [Freses & Noetel 92], [Gaitanides et al. 94], [Meffert 86]. Within the science community this area is referred to as "after sales marketing". New aspects to handling feedback arise when taking the new feedback channel Internet/ WWW into account:

World Wide Access

By being accessible from anywhere in the world a company has to consider that feedback is coming in from anywhere, too. Some feedback has to be translated. Regional characteristics concerning the company (e.g. price difference, model variation) and the country (e.g. differences in judicial system, culture) have to be taken into account. A company has to provide a structure to access distributed experts for these different fields of expertise.

Direct Access to Headquarters

Customers do not have to go to their local distributor as the only representative of a company but now have the possibility to get in contact with headquarters. This instance in its own gives customers a feeling of being closer to the expert with their concerns. Customers experience a much more direct and simple access to a company than they had before. A company has to live up to these expectations with competent and fast replies.

Little Effort/ Costs

Another factor that has to be considered is the little effort it takes to send an e-mail in comparison to a letter. Customers do not have to sit down and write a letter, pay for postage and get it to the next mail box. They also do not have to find out the right address or telephone number. A link within the web page is all they have to click and the e-mail tool does the addressing and sends the mail off. This breaks down barriers for customers to actually send in feedback. A company has to deal with more feedback coming in.

Fast and Reliable Delivery

If customers use electronic mail they do not have to take days of travelling time for a letter into account, but can send feedback about urgent problems in and expect feedback to be answered within a short time. There is also no need for watching opening hours because customers can send e-mails at which ever time of day. Feedback that would not be posted because the phone was busy or it was to late in the evening will now be sent in and leads to a larger amount of feedback also.

These four aspects to Internet feedback are a chance and also a duty for a company. By getting direct feedback from the end customer a company gets in contact with the consumer and can use this feedback to improve their customer relationship and also their own products and processes. But it also calls for allocation of additional expertise, a well structured organization for efficient access to this expertise, a greater amount of experts and an efficient answering process to serve the demand for fast response.

3. The "Management of Feedback" Process

Considering a typical instance of the "Management of Feedback" process it could look like shown in [Fig. 1]. A customer visits a company web site and sends some feedback to the company. The company's web server receives the feedback hands it over to some matching mechanism, which determines an expert. If a customer's question has more than one aspect a second expert might be considered before the answer is sent back to the customer. The Customer Interaction Management System (CIMS) proposed by this paper acts as a tool to support all steps within this process.

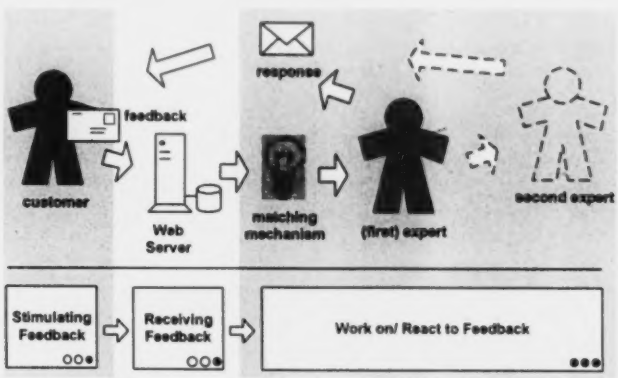

Figure 1: "Management of Feedback" Process

Assuming a systematic management of customer interaction this process of managing feedback can be - according to "Active Complaint Management" [Stauss & Seidel 95] - divide into three separate steps "stimulating feedback", "receiving feedback" and "work on/ react to feedback" [Fig. 1]. The black dots symbolize the weight of a topic within the work described by this paper.

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3.1.1 Stimulating Feedback

Stimulating feedback covers every action and possibility, which is offered to a customer to get in contact with the company. This means customers should not be confronted with obstacles when they want to get in contact with a company. It furthermore means they should be encouraged to give feedback and find a possibility to enter feedback easily where they expect it to be. This should be done with respect to the capabilities of a company to cope with incoming feedback. E.g. if a company only has a few employees who are already very busy and the company is not willing to employ any extra people then a company should not put a feedback button on every page of their web site. People will use this button and feedback will come in and there will not be enough experts to give competent answers. This puts the company in a bad position on it's own fault. Main points of stimulation feedback in this context are (a) establishing efficient feedback possibilities for customers, and (b) adapting feedback possibilities to internal resources.

3.1.2 Receiving Feedback

Feedback can be received by a company through many different types of media like Internet, telephone, fax or letter. Within the work described by this paper only feedback coming in over the Internet (or Intranet/ Extranet) and received by the web server is considered. An important point is a structured way of collecting and storing customer feedback for later work with it. But receiving feedback is not only a task that concerns the company. It also includes that customers have to be informed about their feedback being collected and transferred to an internal expert. Furthermore customers have to be told what to expect next after a company collected their feedback. Questions customers ask themselves are (a) what do you do with my feedback and (b) when do I hear from you again. This is often omitted by companies but is essential for good customer relations. The other objective for a company is to collect all information concerning the feedback. It should be stored in a way that an expert can use former feedback and answers as a reference for similar questions. Often times feedback is just sent to an expert via e-mail and it is up to the expert to store and utilize it.

3.1.3 Work on/ React to Feedback

The main focus of this paper lies on handling feedback once it has entered the company through the web server. In more detail this covers the question how to react to feedback appropriately and how to support the process of feedback handling within the company. This leads to methods of process and time management, which determine the design of internal work processes for feedback answering. What this means on an abstract level is shown in [Fig. 1]. It is the matching mechanism, which determines an expert, the process/ workflow management that directs the feedback to an expert (or to several experts) and the communications aspect towards customers regarding the answer. Another aspect of this process step is the interface to the indirect "Management of Feedback" process mentioned in the following chapter.

3.2 Spectrum of "Management of Feedback"

The above mentioned "Management of Feedback" process does not include further evaluation and interpretation of the feedback for use within the company. Therefore a direct and indirect "Management of Feedback" process is distinguished. In the direct process a customer is "directly" involved whereas in the indirect process a customer does not participate. The indirect process reveals great potential for a company because it helps to improve the quality of products and services.

Within this paper possibilities of analyzing and utilizing feedback within the company are not extensively discussed. The general possibility is kept in mind and adequate interfaces are pointed out. [Fig. 2] shows both processes and also the framework influencing them. Dealing with the "Management of Feedback" process means considering this surrounding framework also. Management of feedback differs quite a lot depending on the organizational structure of a company, the technical abilities and the personnel being available for feedback handling. The competitive framework also has influence on the "Management of Feedback" process but is considered given can not be directly influenced by a company.

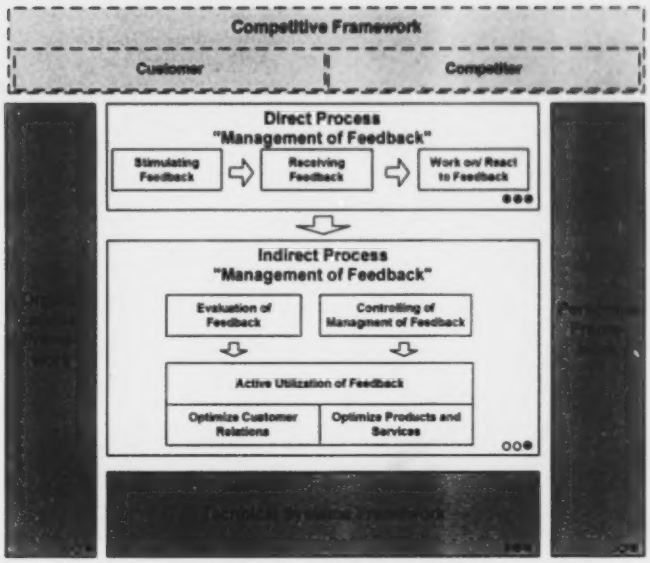

Figure 2: Spectrum of "Management of Feedback"

4. The Customer Interaction Management System (CIMS)

The Customer Interaction Management System supports the third step of the direct "Management of Feedback" process "work on/ react to feedback" as described below. As shown in [Fig. 1] there are 4 subtasks to support within this third step: matching feedback to experts, supporting process management with workflow functionality, communication with customers and interfacing to the indirect process.

The first two steps "stimulating feedback" and "receiving feedback" are covered by CIMS by means of a common simple user interface for entering feedback and a well structured database to store feedback and secondary information like the web page where the feedback originated from.

4.1 Matching Mechanisms

In general one can differentiate between static and dynamic matching of feedback to experts. Static determination means an expert is identified before feedback is posted. In this case the feedback content is not relevant and matching is based on web page content or because a customer is known and always contacts an area representative. This second method only works if customers are willing to identify themselves by name or e-mail address.

Dynamic matching is more flexible but also more complex. The expert can be determined automatically by use of classification or pattern matching software, which analyzes the actual feedback content [Bayer et al. 98] or manually. This second possibility can be furthermore divided into single step, where some central incoming point (e.g. webmaster) distributes feedback after clearly identifying an expert, or multiple steps where a fair match finds a first exert and leaves it to this expert to answer or find a second better qualified expert.

In many cases a combination of matching mechanisms is used especially if matching is not successful on first try. CIMS supports all methods of expert determination and also the combination of these. When experts are presented feedback to answer, they are also informed about which of these methods led to them as a specific expert. And if they then decide that the method was not accurate they can choose to train the method by evaluating and rating keys. Another feature, which offers great flexibility to CIMS, is the possibility for experts to change a matching mechanism that led to them. For example if an expert does not like to be associated with all feedback from a certain page (static/ based on content matching) he/ she can cross this matching mechanism out and choose to be determined by hand (dynamic/ manual matching) from now on. This would take him/ her off the page and later feedback to that page would have to be directed to an expert manually. This flexibility can be achieved because the relation between page and matching mechanism is stored in a database.

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4.2 Process Management/ Workflow Management

Process or Workflow Management of some sort is needed for all static and dynamic matching mechanisms as soon as matching fails. Some expert receives feedback because his/ her name was associated with a page but he/ she has no idea of what to answer and does not feel competent. In this case he/ she needs some help on how to find a qualified expert. The matching mechanism then shifts from static to dynamic/ manual. And for an expert determination, which runs through multiple steps – which this determination becomes in this case –, it is very obvious that support for feedback handling by a workflow system is needed.

CIMS supports this type of dynamic workflow. Feedback is entered through CIMS and has therefore automatically entered the inherent workflow system. The workflow maybe simple if the competent expert is found right away but the opportunity to handle more complex workflows is given. Experts have access to a knowledge tree and are able to manually redirect feedback to a different expert if they do not have the expertise. Experts may also be added to the tree dynamically. The workflow itself always has a basic structure as shown in [Fig. 3]. Some process steps within this workflow are more elaborate depending on the specific instance of a feedback and the according matching mechanism. This general structure also shows which role is active on which process step by the small icons next to each box taken from the role model.

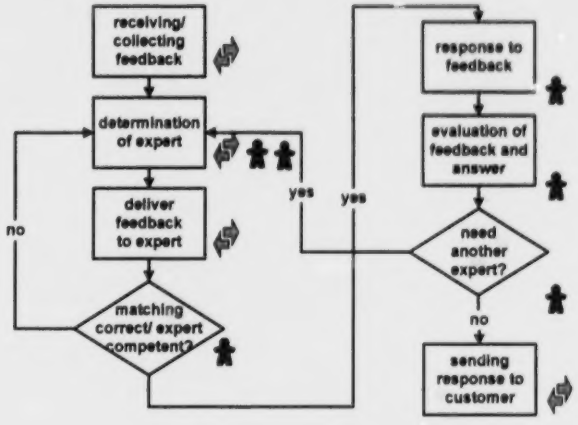

Figure 3: CIMS Workflow

4.3 Communication with Customer

Communication with a customer is ensured through the workflow engine of CIMS. Incoming feedback is marked with a timestamp. Based on this timestamp a due date is calculated when a customer has to be informed about the progress in answering his/ her feedback. This could be a final answer or a short message that the question has not been dealt with yet and for what reason it has not been dealt with. Internally exceeding the due date triggers an escalation mechanism, which informs first the expert, and, if he/ she does not react, the CIMS administrator. Customers that enter an e-mail address get their answer via e-mail others by conventional methods or they can find it in an open forum on the company web site.

4.4 Interface to Indirect "Management of Feedback" Process

As CIMS uses an open architecture all stored information is accessible and available for further use. CIMS is completely based on Internet standards like HTTP, HTML, JavaScript and SMTP. The implemented prototype has a principle structure as shown in [Fig. 4]. To further simplify data access for systems from the indirect "Management of Feedback" process a CORBA server handles access to the SQL-database. Systems form the indirect process only need to comply with CORBA and can access data instantly. Mail, that experts receive never contains the actual feedback or question but only a link to a dynamically generated feedback-answering-page that experts access via the web server. This ensures data integrity and allows secondary systems to analyze the complete data sets.

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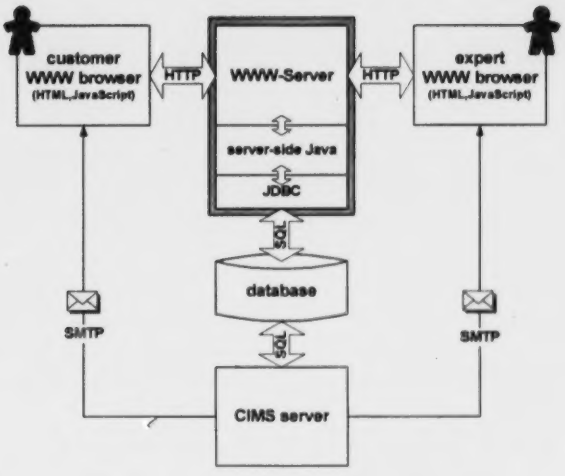

Figure 4: Architecture of CIMS Prototype

5. Conclusion

Many web sites have flawed or serious problems with customer feedback management [Grund-Ludwig 97], [Wiedemann 98]. Many companies not to seriously respond to web based customer questions and feedback when compared to traditional methods of interaction with customers (e.g. face to face, through mail or telephone or questionnaires). Most people have had the experience of sending email to a web site and receiving either no response or an inadequate response. The key problem for companies is how to quickly direct feedback to the correct expert. This becomes a greater problem especially for companies that are distributed and have different types of infrastructure. Because of this some companies do not have a way at all to include competent experts in this feedback workflow and leave it to non-expert employees to give generalized feedback.

CIMS addresses exactly this problem and offers advantages for web sites without structured feedback handling by coordinating workflows between customers and experts - thus taking the customer inside the company.

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Outcomes Assessment of the Web-Assisted Format at the University of Phoenix—Phoenix Campus

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Abstract: For more than 40 years researchers have looked at the outcomes generated by distance learning classes; however, many of these researchers have primarily focused on grade comparisons or opinions of students and faculty regarding the *worth* of a particular class. These assessments do not measure the learning outcomes of a course. The Phoenix Campus constructed a criterion-based instrument, based on University of Phoenix curriculum and tested the learning objectives covered in a Master of Business Administration program. Specifically, the instrument was used to test for significant differences in the learning outcomes of students in the Web-Assisted Format and traditional program. Preliminary results will be shared at the Web Net '98 Conference.

University of Phoenix Background

The University of Phoenix has presented educational opportunities for adult learners for over 20 years. With its 65 campuses and learning centers operating in 12 states and Puerto Rico and enrollment over 49,000, the University of Phoenix is the largest private university in the United States. In addition to campus locations, the University of Phoenix offers degree programs through distance learning initiatives. The Center for Distance Education allows students to work on an individual basis with faculty, while the Online Campus uses the Internet to provide a collaborative learning experience. In addition to offering classes to residents in the Phoenix metropolitan area, the Phoenix Campus serves Casa Grande, Flagstaff, and various off-site locations (Boeing, TRW, City of Mesa, Bank of America, etc.).

Web-Assisted Format Rationale

University of Phoenix students are working professionals maintaining active work, family, and educational lives. Sometimes students in programs must miss a class session due to business related travel. Phoenix Campus administration wished to service these and other students who may not be furthering their educational careers because job responsibilities prohibit them from making a firm commitment to attend class physically each week.

While the Online Campus and Center for Distance Education offer degree programs through distance delivery, the Phoenix Campus aimed at *bridging the gap* between classroom instruction and the on-line environment. This option brings the learner closer to the "anytime, anywhere" model in some distance learning programs [Baker 1998], yet retains the familiarity of the classroom environment. Various researchers have purported simply exposing students to a computer rich environment increases learning outcomes [O'Grady 1998]; however, the Phoenix Campus realizes that any form of computer-mediated instruction cannot account for, nor replace, face-to-face instruction [Burgstahler 1997] or inherently raise learner outcomes. The combination of classroom environment with distance learning technology is not new and has been piloted in K-12 environments [Berge & Collins 1995]. For example, in one collegiate distance learning end-of-course survey, 19% of the responses indicated a preference for a combination of in-the-class and Internet delivery modes rather than either method alone [Kubala 1998].

The Web-Assisted Format

The Web-Assisted Format currently is restricted to graduate level studies because participants are required to own or have access to a computer, the Internet (World Wide Web), electronic mail, and a strong commitment for self-directed instruction. The format was designed so students may attend class while at work, on the road, or at home—not in one of the campuses' computer labs.

Graduate courses at the University of Phoenix typically last six weeks (for three credit hours). In the Web-Assisted Format, students meet on-campus for weeks 1, 3, 5, and 6. This allows Internet instruction and travel during weeks 2 and 4. Class sessions occurring on-line are conducted via an interactive web-based conference system. Within each class lectures provided by the instructor, discussion questions, and activities related to the learning objectives are posted in the class conference area. Since each course taught at the University of Phoenix stems from the same University-wide curriculum, students at the Online Campus, Phoenix Campus, Florida Campus, and Center for Distance Education essentially receive the same education. Only the presentation made by the individual instructor is different. The instructional model used by University of Phoenix focuses on interactive discussions and application to the "real world" environment. Kubala [1998], speaking with regards to on-line classes said, "students must be challenged to use their higher cognitive skills to research, solve problems and inquire about their answers to course materials and posted questions." Since regular classroom instruction is conducted in this manner, the transition from the classroom to the Internet environment is less threatening to faculty and students.

Assessment History

The Internet has been called "the most comprehensive communication system ever developed" [Crossman 1997]. Whether looking at the roots of distance learning in the 1900s or the latest developments in Internet technology, "there can be little doubt that distance education can be very effective in bringing about learning" [Moore & Kearsley p. 59 1996]. Research comparing distance learning to classroom-based learning has been conducted for over 40 years. In that time, no significant difference has been found between the two instructional methods or its outcomes [Moore & Kearsley 1996; Williams & Brown 1991]. These assessments have covered a wide range of relevant issues, such as end grade analysis and faculty opinions [Barker 1998; Krueger, Porter, & Burke 1998; Moore & Kearsley 1996; Verduin & Clark 1991]. However, the projects, while important, do not address the learning outcomes between the two delivery modes [Moore & Kearsley 1996].

University of Phoenix Assessment Study

Henderson [1998] recommends that distance learning programs should be assessed the same as campus-based programs. Borrowing from Nevin, Thousand, Hood, and Parsons [1998], the Phoenix Campus began preparing an outcome-based assessment for the Web-Assisted Format. The assessment would compare learning outcomes of students in the Web-Assisted Format to those taking a campus-based program, theoretically showing no significant differences in the learning outcomes. Students in the Web-Assisted Format and the classroom-based group completed the same introductory course sequence of Marketing, Business Law, and Organizational Management. Since every course was taught experienced University of Phoenix faculty (using the same curriculum), the learning objectives in each course were identical.

The initial assessment took place after the two groups completed the third course in the Master of Business Administration program (Organizational Management). Each faculty member who taught in the two formats (three in each format) were contacted and asked to write ten questions covering the learning objectives in the course they taught. This created 20 questions per course and a total pool of 60 questions. These questions were reviewed by the campus Academic Affairs Office to ensure validity against the learning objectives.

Each of the 20 questions per course was assigned a numbered value. Using a random number generator, the first ten questions were selected for the assessment instrument. This process was repeated for the remaining two course question pools. Special care was taken to ensure that 50% of the total questions were contributed by each learning mode faculty. Allowing faculty members from one of the delivery modes more input on the instrument may have skewed the results as shown in Nevin et al. [1998].

The two groups arrived on the Phoenix Campus and completed the instrument on October 31, 1998. After scoring the instrument, a Chi-squared contingency table was constructed for each test item. Significance was tested at the .01 alpha level comparing student scores in the Web-Assisted Format to those in the campus-based group. Preliminary results will be shared at the Web Net '98 Conference hosted by the Association for the Advancement of Computing in Education.

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Saudi Arabia and the Internet Technology

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Abstract: While Saudi residents anxiously await the introduction of the Internet into Saudi Arabia, many have already started taking advantage of the services of the Internet through neighboring countries of the Arabian Gulf peninsula. This paper will take a brief look at the main reason for delay, current status, and current applications of the Internet technology in Saudi Arabia.

Introduction

The Internet without any doubt is one of the fastest growing technologies the World has experienced. Certain statistical studies [see Network Wizards] predict that the number of Internet Hosts will reach 100 Million hosts by the year 2000, a tremendous jump from 29 Million in early 1998. Putting this in mind one wonders why certain countries have yet to take full advantage of this technology. In some cases, the financial situation and lack of technological advancement in certain 3rd World nations make it a secondary issue to be concerned with at a later time. In the case of the Kingdom of Saudi Arabia, there is no lack of financial resources, nor that of technological advancements. The Saudi government spends a great effort providing its residents with the best, and most current technologies, services, and resources in the World. The remainder of this paper will present the main reason for the delay in the introduction of the Internet to Saudi Arabia, the current status, and how certain organizations in the Kingdom have already taken advantage of the Internet technology.

Reason for Delay

Saudi Arabia is a country that has long upheld excellent cultural and religious values. There are many forms of censorship prohibiting anything thought to be socially harmful and against the morals and teachings of the dominant religion in the country, Islam. The Internet, with the additional services of the World Wide Web (WWW), has become a type of media source that provides access to many different types of information that is difficult to control.

On a global level, most of the Islamic nations have been slow to join the rest of the World on the Internet. Many concerns about the types of immoral material found on the Internet have been behind the hesitation to climb onto the information superhighway. Even more hesitant, have been nations of the Arabian Gulf peninsula.

On the Saudi level, many scholarly discussions and debates have been conducted to study the negative and positive affects of the Internet on the Saudi society. The main negative affect being the possible moral and ideological corruption of the younger generation through their exposure to material that is normally not accessible within the Kingdom. This represented a strong argument against the Internet and managed to prevent its introduction to the general Saudi public.

Current Status

The increased pressure to join the international community, already utilizing the many benefits of the Internet, has caused Saudi Arabia to reconsider its earlier decision. Knowing that its smaller neighboring nations of the Arabian Gulf peninsula have gotten connected to the Internet, and that many

of Saudi Arabia's citizens have started accessing the Internet through those nations, it became more imperative for Saudi Arabia to be the provider of these services to its own citizens. Comforted with the knowledge that firewalls and proxy servers can be used to filter-out undesirable material, a decision was finally made in April of 1997 approving the introduction of the Internet to the Saudi society.

The King Abdulaziz City of Science and Technology [see KACST], an organization conducting and funding different types of research within the Kingdom, and the *.sa* top-level domain (TLD) manager, was assigned with the responsibility for coordinating all efforts necessary to bring about services of the Internet. KACST and the newly established Saudi Telephone Company (STC) are working closely to setup an appropriate networking structure within the Kingdom that would enable fast access to the Internet for all users.

An initial plan has KACST, positioned in the country's central region, as the main node linked to the Internet via a satellite link. The Eastern and Western region network nodes will also be linked to the Internet in the initial plan via the KACST node [Fig. 1]. Each of the three nodes will then act as connecting points to local government agencies and Internet Service Providers (ISP's). After the successful implementation of this initial plan, other regions of the country will be connected as well.

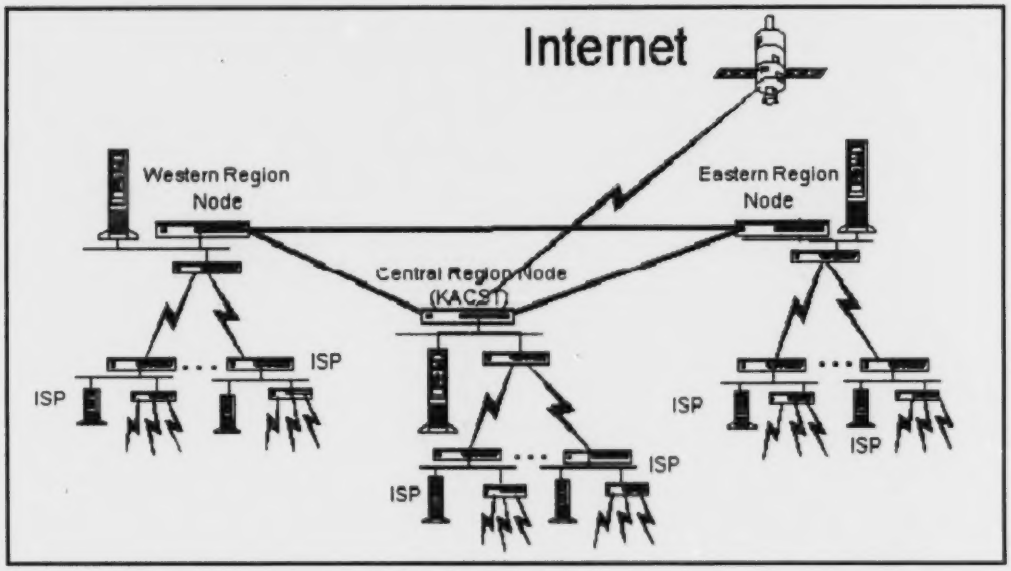

Figure 1: Initial Planned Internet Network in Saudi Arabia

Currently, a process is nearing completion, by which, a number of companies would be granted licenses to act as Internet Service Providers (ISP's). This process is a move away from the typically monopolized provision of Internet services seen in other Arabian Gulf nations, typically provided by their Ministries of Post, Telegraph, and Telephone (MoPTT).

Applications for ISP were submitted by almost 160 companies. Realizing that no existing companies within the country have experience as ISP's, the application forms were structured in a way to determine the level of each company's technical and financial preparedness to assume the role of an ISP. Once companies are qualified as ISP's, they must adhere to the rules and regulations set by KACST. Failing to follow specified rules will cause an ISP to lose its license. Internet services are expected to start by late 1998.

Arabian Gulf Communications Network

Even though Saudi Arabia has no direct connection to the Internet, it has long been a member of a regional network linking Arabian Gulf countries. In 1985, KACST was established as the main node in GULFNET, a network linking academic and research organizations of the Arabian Gulf states.

GULFNET enabled users access to services available at KACST such as the National Bibliographic Database, as well as, access to library services at several universities.

In 1987, GULFNET was linked to BITNET, one of the largest academic and research networks in the world, linking 400 U.S. universities with links to many other international networks including the Internet. This connection was established between KACST and George Washington University in the United States of America. This gave greater value to GULFNET by making useful BITNET services available to the users of GULFNET. These services include list servers that provide means for creating forums for discussion and information sharing in a given topic. In addition, since BITNET has many gateways to other major computer networks such as Internet, users of GULFNET were able to exchange email messages with millions of other users world-wide. By December 1996, KACST had converted its GULFNET BITNET links to TCP/IP protocols [see Burkhart and Goodman 1998].

Organizations Already Having Internet Access in Saudi Arabia

As seen above, there is no direct public access of the Internet in Saudi Arabia as of yet. However, a few organizations have had special connections to the Internet. In this section, some of these organizations are mentioned.

King Faisal Specialist Hospital and Research Center

Even though the Internet has not been approved until very recently on the national level, one research organization has long been allowed direct satellite access to the Internet. The King Faisal Specialist Hospital and Research Center (KFSHRC), the leading hospital in Saudi Arabia and the Middle East, has enjoyed services of the Internet since 1994. KFSHRC has a T1 (1.544 Mbps) satellite link provided as part of the Saudi American University Project for Tele-medicine with a 128 Kbps allocated for the Internet connection. The reason for granting Internet access to KFSHRC was mainly based on the hospital's well-known reputation within the Kingdom, and its need to conduct valuable medical and operations research.

King Abdulaziz City of Science and Technology

The second organization to be granted access to the Internet is the King Abdulaziz City of Science and Technology. Following its previous role with GULFNET, and its assigned responsibility for bringing about the Internet to the Kingdom, it made perfect sense that staff of this organization are granted access to the Internet. KACST's Internet connection is a modem link through KFSHRC.

SaudiNet, an ongoing project conducted by KACST is linking Saudi universities and research institutes in a nation-wide network. It is through this network that these institutions are expected to get their Internet access via KACST. Currently most universities have already been linked to KACST and are expected to be the first to get official Internet access. The geographical closeness of KACST to King Saud University (KSU) has this university as the first logical recipient of the Internet.

King Saud University

The most recent to gain Internet access is the King Saud University. Over the past few years, KSU has mainly had email services through GULFNET. Just recently, with the start of the Fall Semester of 1997, email was changed to Internet email. Starting with the Spring Semester of 1998, KSU was granted modem access to the Internet through the King Faisal Specialist Hospital and Research Center. This connection, however, in not university wide, and is strictly limited to faculty and staff members of the College of Computer and Information Sciences.

A WinGate proxy server is installed at the KFSHRC end, which restrict the types of information that may be accessed through the Internet. Any Web site containing words that are deemed tasteless are blocked out. This creates a problem when attempting to access some scientific Web sites that discuss matters regarding certain parts of the human anatomy for example.

Organizations with Web Sites

Many Saudi organizations and companies did not wait for the Internet to enter the Kingdom. They listed their Web pages with international Web hosts mostly in the United States and the neighboring island nation of Bahrain [see Alkamily and Alhusseini 1997]. Some of the Saudi Web sites that can be found on the Internet are mentioned in this section.

Saudi Embassy in the United States of America

A very comprehensive Web site about Saudi Arabia can be found at (http://www.saudi.net). This site provides valuable information to anyone who is interested in learning about this country. Information about its history, government, culture and arts, industry, economy, transportation, education, religion, and, much more, can be found at this site.

The Saudi Arabian Ministry of Education

This site; which can be found at (http://www.mohe.gov.sa), is the first Web site for any Saudi ministry. The ministry's Web site provides valuable historical and statistical information about education in the Kingdom. It also provides information about each of the seven major universities of Saudi Arabia. Currently, only one university, the King Fahad University of Petroleum and Minerals (KFUPM) has its own domain address at (http://www.kfupm.edu.sa).

The King Faisal Specialist Hospital and Research Center

KFSHRC has a Web site at (http://www.kfshrc.edu.sa). This home page contains links to many useful medical related international Web sites. It also allows access to the hospital's Intranet containing different types of information about the hospital, including specific department pages, medical professionals and staff information pages, employment opportunities, and, schedule of upcoming symposiums and events. The site also allows the ability to perform searches on web pages of the hospital, as well as, the search for employees phone numbers.

Other Organizations

A few other Saudi Arabian organizations have Web sites, these include the Saudi Arabian National Airline: (http://www.saudiarabian-airlines.com), as well as many other private businesses, newspapers, and banks. Some of the Saudi business institutions on the WWW can be found at (http://www.arab.net) and (http://www.saudi-online.com).

Intranets in Saudi Organizations

Many Saudi organizations, while awaiting physical connection to the Internet, have developed Intranets within their organizations to be used by their employees for information sharing and accessing of organization policies and regulations. These organizations include governmental institutions, banks, newspapers, universities, and private businesses. Certain organizations also allow public access to their Intranets through dial-up lines simulating the feel and look of the Internet. The following are just a few examples.

King Saud University

The King Saud University Intranet is one good example of how the Internet technology has been used in the Kingdom of Saudi Arabia. It currently provides home pages for all scientific colleges of the University. Each department in the College has its own home page relating useful information such as

program curriculums, course descriptions, specific course home pages, graduation policies, and faculty information. Other types of links on the University Intranet include user manuals to programming and software tools, local conference proceedings, students chat areas, and a link to the University's central library database.

Al-Rajhi Banking and Investment Corporation

One other example, this of a private banking organization that has utilized the use of the Internet technology, is the Al-Rajhi Banking and Investment Corporation. This bank allows its clients modem dial-up into their Intranet system. [see Al-Rajhi 1997] Clients are able to check their account balances, transaction history, and, stocks and currency rates. Clients are also able to access general information about the bank and its activities.

Al-Jazirah Newspaper

This nationally popular newspaper has created an Intranet that customers can dial-into to read the latest news on-line. News can be read in both the Arabic and English languages. Customers can also post advertisements on the newspaper's server. Al-Jazirah also has a Web page on the Internet, which can be found at (http://www.Al-jazirah.com).

Internet Solution Providers

A few companies already exist in Saudi Arabia that provide Web Page design and hosting services. Web Pages are hosted with mostly American and Arabian Gulf Web hosting companies. One of the most popular services including over 4,000 pages is the Saudi-based Arab Net (http://www.arab.net). This web site provides a vast array of information about the Arab World in general. It also provides home page directories of Arab businesses listed with this company.

Conclusion

The Internet is on the doorsteps of Saudi Arabia. Much publicity has been made about this great technology. Saudi newspapers and magazines are continuously writing articles about the Internet and always updating the public on organizations establishing sites on the WWW. Local conferences and symposiums held at universities, hospitals, and other government institutions are regularly conducted with the main topic being the Internet. Tools for Arabic language Web browsing and publishing have been developed by local companies, as well as, by the two giants, Microsoft and Netscape. All of this has left Saudi residents impatiently awaiting the day when they can actually experience the greatest hype of the century on their own.

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The Use of TopClass

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Abstract: This session presents the use of TopClass (http://www.wbtsystems.com/guides/index.html), a course management system, with an undergraduate course in communication disorders taught at the University of Minnesota, Duluth (http://www.d.umn.edu/topclass/help/info.html). The session presents the use of the discussion forum section as a forum for out of the classroom assignments. TopClass is a tool that facilitates the development, management, and delivery of asynchronous Web-based teaching-learning environments. QuickTime technology was used to present speech samples via the World Wide Web (WWW). The students listened to the speech sample files, then submitted his/her comments back to the instructor about the nature of the speech disorder. This process was used as a way teaching students what to listen for and also tested the students' skills in determining a speech disorder diagnosis. The availability of speech samples on the WWW allowed students to use this resource at their own learning pace and use this resource as many times as it is necessary for them to become reliable listeners.

Purdue University's Online Virtual Visit: A Visitor's Information Resource

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1.0 Introduction

With the wide and rapid acceptance of Apple's QuickTime VR™ technology, the department decided to create an interactive campus map that would allow visitors to view photographs and QTVR clips of the various campus buildings. It was planned that the Virtual Tour would also include text-based information from a variety of brochures used by the University Visitor's Information Center. Additionally, with the release of anti-aliased vector formats for Web graphics, the vector-based 3D map from one of the brochures could also be integrated into the site.

The purpose of the map was to create a single university resource that could be used for informational and marketing purposes by the department, the School of Technology, and the university. Additionally, several internal departments, such as the Visitor's Information Center and the University's Office of Publications showed a sincere interest in utilizing the site. As stated by the Office of Publications, "having video clips on the Web would extend the marketing ability [of the university] by providing much more than a single brochure or even a tour can provide." Providing the Virtual Tour on the Web was seen as having several unique benefits over the traditional marketing materials used by both the Visitor's Center and the Office of Publications. Time-independence, global accessibility, dynamism, interactivity, and editability all proved to be benefits of using the Web to deliver the Virtual Tour.

2.0 Project Development

The development of the Virtual Tour site required four different media elements to be integrated within the site Text, photographs, QTVR clips, and standard Purdue mastheads and footers were used throughout the site. The standard mastheads and footers were created by the Webmaster of the School of Technology and all work was performed in accordance with school and university regulations concerning the development of pages and sites. It was decided that the pages would utilize standard HTML, Active Server scripting (ASP) and JavaScript.

The text for the site was obtained through the University's Office of Publications and was written by staff writers. The photographs and QTVR clips were created by students during the early part of the summer session. Prior to creating the photographs, several locations were targeted and trips were made "into the field" to determine the best location for the shots. A review of literature pertaining to QTVR revealed that distant objects (object close to the horizon) are often clipped, distorted or deleted when the panoramic views are created. Additionally, to choose the best location for still photographs required knowledge of the surroundings. Therefore, each location was examined to determine the best location for highlighting the university buildings.

Aside from the external clips that were generated, it was also decided that several indoor clips would also be needed. Appropriate locations, such as Mackey [basketball] Area, the Ross-Ade [football] stadium, the Co-Recreational facility, and the Mollenkopf athletic facility were targeted and arrangements were made to photograph these facilities.

Although the predominant technology on the Virtual Tour site was QTVR, Macromedia Flash™ was also used. Macromedia Flash™ allows vector-based elements to be seamlessly integrated into the Web without the characteristic aliasing that typifies vector artwork. Flash also provides interactivity, navigation, and

sound with incredibly small file sizes as well as the ability to dynamically size artwork without a change in file size or a decrease in visual resolution. Therefore, Flash was used to create the 3D map for the Virtual Tour site.

3.0 Resources

To create the Virtual Tour site required the purchase of several pieces of hardware to create the photographs and the QuickTime VR™ clips. An Olympus 600-L was purchased for the project due to its ability to create high-resolution images, to store photographs on removable 2 MB, 4 MB, and 8 MB flashcards, and to download to both Macintosh and PC-based computers.

To create QTVR movies requires that multiple photographs (12 to 28) be taken in a circular pattern around the camera. The number of photographs required to create the panorama depends upon the lens size and orientation. The photographs are then stitched together to create a single seamless image using special QTVR software. Since photographs of the surroundings are taken all the way around the camera, the resulting movie appears as if the camera is rotating 360 degrees in the environment during navigation. To avoid banding and severe parallax, the overlap between adjacent images must be between 30 percent to 50 percent. For the Olympus camera, it was determined that 20 images would provide adequate overlap for the stitching process.

To quickly and successfully obtain source material for QTVR movies, it is imperative that the camera only rotate around a single axis while taking the photographs and that the rotation occur at precisely the increments specified for the camera lens. Therefore, a tripod and secure mounting bracket must be available. Additionally, it is beneficial that the tripod have leveling bubbles to ensure that the camera is parallel to the ground plane. Several manufacturers have created special QTVR mounts that contain grooves that are incremented to the settings required by various camera lenses. Many of these tripod heads also have an integrated leveling mechanisms. The grooves in these mounting heads act as detents to allow photographs to be taken at specific degree rotations. To create QTVR movies with the Olympus 600-L, the Kaidan Kiwi+ was chosen and a detent disc of 20 was chosen. This particular head requires that the camera be mounted in a portrait orientation and it also has an integrated leveling mechanism.

In addition to the hardware used for the project, several pieces of software were also acquired for execution of the project. To create the vector-based artwork, existing illustrations were imported from Macromedia FreeHand™ to Macromedia Flash™. These two products are tightly integrated and allow several importing and exporting features from one to another.

To create the QuickTime VR panoramas, Apple's QuickTime VR Authoring Toolkit version 2.0 was used. Although this package is only available for the Macintosh at the time of this writing, it may be available for the Windows platform at a later date. The software allows the images to be imported, stitched together, and output as a panoramic movie file. The software allows the camera lens information to be entered into the computer and the resulting skew and stitch operations are based upon the entries. The generated movie files may be used on both platforms if version 3.0 of QuickTime is available. For older versions of QuickTime, movies must be converted to QTVR version 1.0.

Acknowledgements

The author wishes to thank the following without whose good will, enthusiasm and dedication this work would not have been possible: Jennifer Rohler, Brian Long, Purdue University Office of Publications, Purdue University Visitor's Information Center.

A Web-Free Prototype for Distance Learning

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Abstract

It would now seem to be essential for a distance learning product to be in some way based upon the World Wide Web. This work presents a prototype for the construction of interactive educational hypermedia that can be used on Internet without being bound to typical Web protocols and tools. Its most innovative aspect is interactivity: it allows teachers and learners to remotely interact in real time, in both a synchronous and asynchronous manner. Web-based educational material leaves the responsibility of navigation to the student. The prototype, instead, allows a teacher to manage the lesson in way that guarantees coherence in the exposition of the arguments, without using CGI, Java or HTML, and without using a Web browser. Furthermore, all the didactic material is produced by the teacher using a multimedia authoring system which allows much more sophisticated expressiveness, greater simplicity of use and a more developed interactivity than that provided by Web-based technology.

Introduction

The Web has given a strong impetus to the concept of distance learning, but in part it has also distorted its meaning. The lack of interactivity, in our opinion, is one of the limiting factors in the didactic approaches available on the Internet and tied to the Web. Currently, with the exception of a few experiments that require complex and expensive technological equipment, distance learning is provided using HTML located on a Web server, with student feedback managed in an asynchronous manner, often using Java programming. This type of hardware/software equipment is not available to most school institutions or teachers, especially with regards the programming necessary. The prototype presented in this work allows for the creation and use of didactic hypermedia using a traditional multimedia environment, which does not require the teacher to deal with HTML, Java, Tcp/Ip, PERL, CGI, HTTP etc. The innovative aspect is the provision of hypermedia which allows the teacher to remotely interact with the students in both a synchronous and asynchronous manner. The Web remains a vehicle that is an accessory and is used simply to transmit the voice or picture of the teacher, in parallel and completely independently of the rest of the prototype. The teacher can therefore direct the lesson in a way that guarantees coherence in the exposition of the arguments. Most Internet-based courseware can be classified, in our opinion, into four types:

- Off-line courseware, composed of a sequence of Html pages, pre-packaged by the teacher and statically connected, in which the student moves at his own pace according to pre-set paths. This is the most frequently used material and it is obvious that it is the most accessible with regards its construction for the majority of teachers. There are a number of didactic problems with this approach, and the absence of the teacher can in no way be substituted by the Web. There are a large number of reports on this subject: see, for example, the proceedings of the most recent ED-Media, ED-Telecom and Webnet conferences [ED-Media95, 1995], [ED-Media96, 1996], [ED-Telecom96, 1996],[Webnet96, 1996], [Webnet97, 1997], [ED-Media97, 1997];
- Developments of the previous approach towards greater interaction, where asynchronous feedback mechanisms are provided, such as E-mail, form based text or partially synchronous (e.g. chat line) methods that are, however, reduced to solely an exchange of texts. These approaches are mainly based on the Java or Vbscript programming languages, and exclude those teachers who do not possess sufficient computer related knowledge.
- On-line Web-based courseware where the material is used during a classroom lesson. Html pages are stored on a Web server and the teacher uses them, during face-to-face sessions, as traditional slides. The advantage of this approach is that the students can use also this material after the lesson has finished for individual study. However, in this case the "distance" factor is completely absent. See, for example, [Bos et al, 1996].
- Systems based, at various levels of complexity, on the use of video-conferencing equipment, (shared whiteboards for example), where the Internet is used as communication channel, although in this sector one really needs to use dedicated connections due to the unsatisfactory performance of the "network of all networks". Again in this sector the Web is normally seen as an accessory, and sometimes it is excluded or used as an Intranet. On the other hand, the bandwidth that is normally available on the Internet certainly does not allow for the mass broadcast of full-motion pictures of the teacher and his lesson.

It can be seen that in the first two categories, interactivity is minimal or reduced to communication that does not intervene directly during the lesson. The didactic materials are permanent but static, and the Web only supplies a channel of communication plus a different language (HTML) for the creation of didactic materials. This is not obviously insignificant, but in these cases the teacher has limited control over the educational process of the student, who in turn must more or less behave as a self-taught-person. For a complete introduction into our conception of interactive didactic material, see [Colazzo & Molinari 1995].

With regards the category of Online Web-based courseware, we have seen how on one hand the Web is used effectively as the technological base for the construction and use of the material, but on the other the interactivity occurs with the physical presence, at the same location, of both the teacher and students. We therefore fall within the two previous categories where there is an absence of interactivity once the student consults the HTML pages on his own. The mechanisms based on video-conferencing pose at various levels the problems of the technological equipment required, the availability of high speed networks and the lack of persistency of the lesson. Furthermore, in this case the main advantage of the previous approaches is missing, that is, the availability to the student of multimedia material that he can consult at any time.

2. Web-free didactic hypermedia materials for the Internet

Our idea of Internet-based didactic materials attempts to unite the approaches we have identified above. The lessons, held during the first years of degree courses in Economics and Computer Engineering, are mostly constituted by electronic books created using Asymetrix Toolbook. These lessons are not HTML or Java based, they do not use the Web as the primary communication channel, but make navigation and use transparent to the student, and most importantly, they do not force the teacher to deal with the advanced aspects of World Wide Web technology. Our position is not one of refusing the Web, or a negation of this instrument as a vehicle for the transmission or use of information. Simply when in 1992 we built our first prototype for the use of remote didactic material via Internet, the Web did not exist. [Colazzo & Molinari, 1993]. In our experiments, the didactic materials were projected during the lesson, with evident advantages for navigation, the distribution of material and its organisation etc. The event of the Web put our approach in discussion and over the years the solutions we have analysed are the following:

- Translate the didactic materials produced into HTML. This language does not have now, and even less so in 1993, the characteristics for evolved hypermedia interactivity;
- Translate the graphical / textual part into HTML, and build the effects contained in the lessons using Java. This solution, other than becoming only recently available, is obviously not suitable for those who already have their materials ready, and we believe the same is true for those starting from scratch, as Java certainly does not have the same specialisation for the production of didactic material that we find in authoring systems like Toolbook;
- Use, through a plug-in, our lessons within a browser. This solution presents several technical problems of speed, size, faithful reproduction of the original, availability of the plug-in for the client etc. and does not resolve the main problem, the lack of interactivity and communication between the teacher and student during the lesson.

We have followed a different route, and use the Internet as a simple instrument of connection between the teacher's and student's workstations, thereby freeing ourselves of the use of the Web and attached technologies. The material is not HTML based and a browser is not required to consult it. Use of the didactic material follows a "reversed" client-server approach, where the client is represented by the teacher and the server side by the students' computers. The teacher operates the client machine which sends codified messages using a pre-defined protocol to multiple servers (the students' computers). In this way the teacher actively directs the lesson using these messages, he decides when the pages are sent and to whom, he answers questions and checks the state of navigation etc.

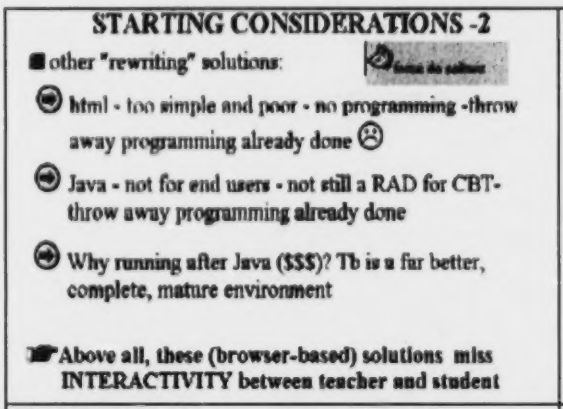
STARTING CONSIDERATIONS -2
other "rewriting" solutions:
html - too simple and poor - no programming -throw away programming already done
Java - not for end users - not still a RAD for CBT- throw away programming already done
Why running after Java ($$$)? Tb is a far better, complete, mature environment
Above all, these (browser-based) solutions miss INTERACTIVITY between teacher and student

Fig. 1 The teacher's screen on entry to the slide

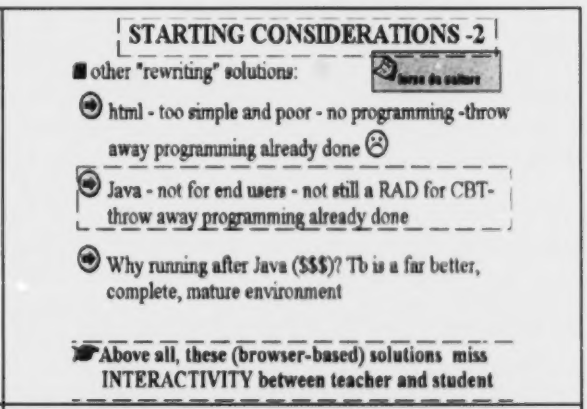
STARTING CONSIDERATIONS -2
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Fig 2 The teacher's screen with several components transmitted to connected students

The teacher's application sends codified commands using a protocol that integrates with TCP/IP but uses a different communication port to HTTP, and the student's application reacts to the commands. Multimedia files, graphics, animations etc. are already present in the student's application, it is only necessary to activate them appropriately. At the current state it is possible to update the student's display by sending a few tens of bytes, whatever the multimedia content is and wherever the student finds himself on the Internet. As one may realise, the Web and the correlated

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technical aspects become completely useless, or it is possible to make use of the communication already in the prototype which use other forms that exploit HTTP or others (Web chat, IRC, Web Phone etc.).
All the elements of the page are only visible to the teacher (Fig. 1), and this reduces the disorientation and the distraction induced by the presence on the screen of elements that have nothing to do with the information content. The students connect directly to the multimedia lesson via Internet to the teacher's computer at an agreed upon time. Navigation of the didactic material is carried out by the teacher, whose actions are transmitted and duplicated on the connected student "servers". The prototype also acts as a simplified multimedia authoring environment, largely based on Toolbook, and also provides several instruments for the management of the lesson. These instruments constitute a sort of "control panel" where the teacher can for example:

- Decide which objects can be displayed on the students' screens (fig. 2);
- See the objects that form the display currently visible to the students (fig. 3);
- Follow a pre-recorded sequence of objects to display, both forwards and backwards (fig. 4), allowing easy lesson management;
- Vary this sequence, by moving objects from their original positions (fig. 4, the hand icons);
- Show or hide all the objects;
- Display the lesson's index, without letting the students see it, and access other pages of the hypermedia while always deciding whether or not to make these movements visible to the students;
- ..... and even more.

These instruments provide a high degree of interactivity during the lesson. Furthermore a permanent base is formed for future study: the material, as it is sent to the student participating in the lesson, remains with him for future use.

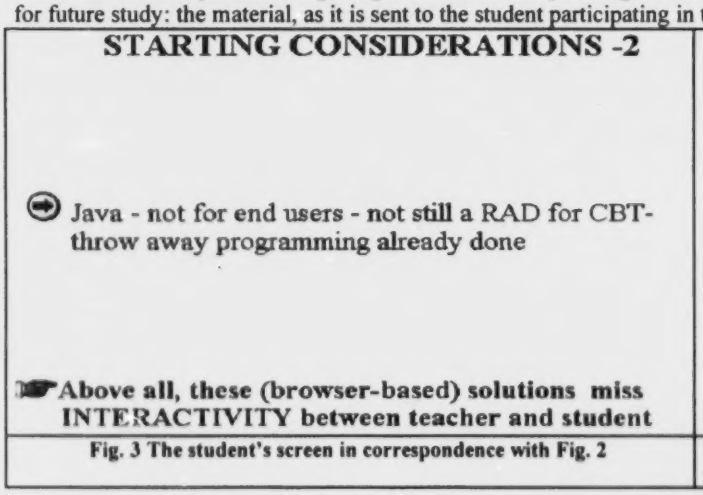

STARTING CONSIDERATIONS -2
Java - not for end users - not still a RAD for CBT-throw away programming already done
Above all, these (browser-based) solutions miss INTERACTIVITY between teacher and student

Fig. 3 The student's screen in correspondence with Fig. 2

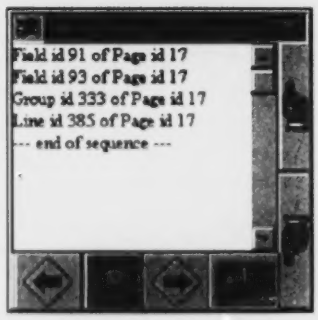


Fig.4 The control of the sequence of actions visible to the teacher.

The configuration of the virtual classroom can take various forms. In figure 5 we show the simplest configuration, suitable for a traditional lesson in which one wants to use the mechanism of the difference between the teacher's and student's displays. This configuration evolves towards situations that are more technically complex but conceptually identical to the previous ones, especially with regards the operations that the teacher must carry out. The real classroom in figure 5 becomes virtual by connecting to the teacher's computer through Internet addresses (fig. 6). In this case the teacher's control over the connections is provided by the simple instrument presented in figure 7.

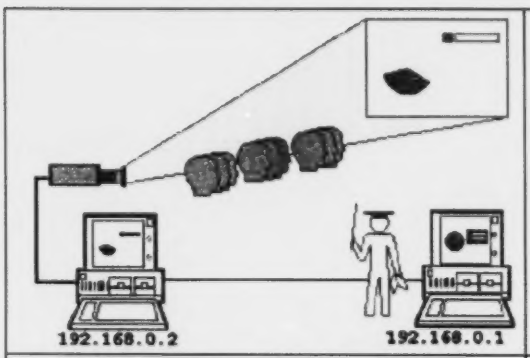
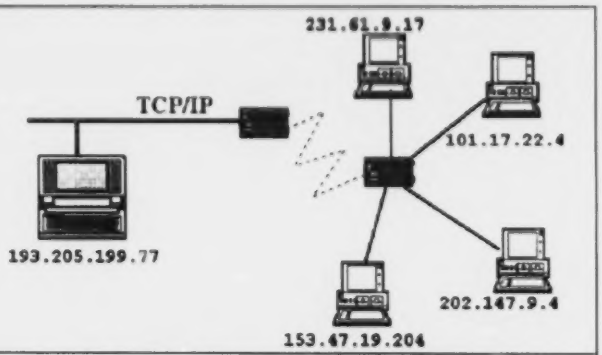


Fig. 5 Configuration for a face-to-face lesson



Fig, 6 A virtual classroom created using Internet.

The setup of the prototype, therefore, provides results both in face-to-face lessons, where the teacher operates two computers, as in fig. 5, and in an Internet/Intranet environment, where the computers are in front of the students and

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are "manipulated" by a remote teacher. The other media involved in the lesson, i.e. the gestures of the teacher and his voice, are provided by parallel instruments to the prototype, such as video-conferencing systems, or audio transmission via Internet. The only use so far experimented with regards the Web, given the limitations of performance and quality, has been the transmission of the participants' voices, using the Internet as communication tool. By using protocols and different ports, the two instruments do not interfere with each other and work perfectly together. Also here there is a notable advantage over traditional video-conferencing. The images of the teacher may be limited to a small window which frames only his face. This means that there is no need to transmit images of the blackboard, slides or other parts of the classroom where the lesson is being carried out, and therefore the use of the network for transmission is drastically reduced. Only the "stamp" sized images of the teacher and his voice travel on the Internet, along with the command codes to pilot the students' hypermedia. This allows the use of low-cost videoconferencing systems, most suitable for students, and low-speed and bandwith connections, like most students and schools have. Figure 8 shows an example of the work environment during the lesson.

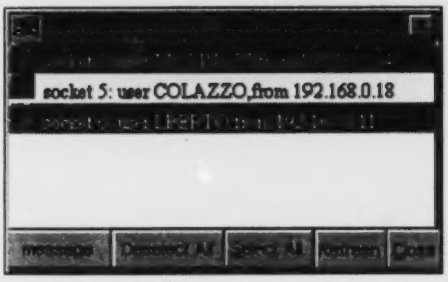

Fig.7 Control of the virtual classrom

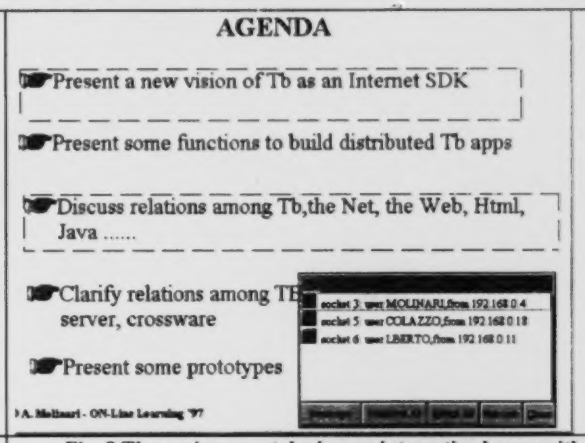
AGENDA
Present a new vision of Tb as an Internet SDK
Present some functions to build distributed Tb apps
Discuss relations among Tb,the Net, the Web, Html, Java .....
Clarify relations among TB server, crossware
Present some prototypes

Fig. 8 The environment during an interactive lesson with the selection of participants

3. Advantages of the approach followed

At the current state of experimentation many advantages have been encountered, mainly regarding the coherence of the lesson which is guaranteed by the teacher's guidance. The most obvious regards the direction of the lesson itself. As the only things visible to the student are those which the teacher desires, this latter can freely operate his own computer, consult other material, open another application, consult personal notes etc. without influencing the lesson and without "disturbing" or having his movements visible on the connected computers. The teacher can manage the lessons' connections, by sending different messages to or operating differently with each student. The prototype provides simplified management for these co-operation mechanisms between student and teacher, and gives a priority role in the direction of communication to the teacher.

Another advantage is provided by the fact that the system integrates a hypermedia development product that is well known and easy to use, without requiring any programming knowledge on the part of the teacher, much less knowledge of Java, Javascript, Vbscript or Perl. The prototype is based on the traditional authoring system Toolbook and interacts transparently with it. When the hypermedia is distributed to the students, it is the activation mode (teacher or student) that determines the behaviour of the hypermedia. This represents a very interesting prospect for environments in which didactic activity is addressed towards trainers: here one thinks, for example, of company training where several people are initially trained to, in turn, instruct other employees.

The protocol created for communication between remote Toolbook applications is an interesting development that is currently not present in traditional WWW applications. Using appropriate commands it is possible to directly intervene on multimedia pages or other remote hypermedia. This allows a teacher to modify or extend the contents of the didactic application during the lesson. At the moment the prototype allows work to be carried out on all the main objects of the Toolbook environment and their properties. It is possible, for example, to change the colour or position of an object, the text of a label, the aspect of an animation etc. It is also possible to change the most important properties of remote objects, i.e. the code that conditions their behaviour. This fact has obvious and important implications in the dinamicity of the lesson. Currently, the issues regarding the security of these operations are governed by flags contained in the protocol and, above all, by the trust established between teacher and student.

The most interesting experimentation is probably in the field of co-operation between teacher and student(s) during a lesson. In the current version, the lesson's "rudder" is firmly in the teacher's hands. A student can intervene in the lesson by electronically "putting his hand up". If enabled by the teacher, at the moment the student can:

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- highlight parts of the page using a marker, to indicate to the teacher the parts that are not clear;
- send a message to the teacher, a message that will be forwarded in broadcast mode to all the participants: the teacher therefore acts as a "relay" for student-teacher messages;
- change several attributes of the objects on the current slide, such as the position, the text, the colour etc., in a way that allows direct communication with the teacher regarding the lesson (for example, a simulation of physical movement carried out by the student by moving objects and checked by the teacher in real time).

Communications that do not pass through the teacher's computer are not provided for, even though there is nothing to stop this. The student can also read back through the sequence of lessons that the teacher did. Feedback management on the part of the students can be organised in various ways: the system also provides a method of recording the moves made by the students for later evaluation by the teacher. This operation is extremely simple, as the teacher's and student's hypermedia are always "aligned". Reviewing what the student has done represents a sort of "slow-motion" play-back obtained by duplicating the student's moves on the teacher's hypermedia.

4. Technical aspects of the prototype

The priority for us, as already mentioned, is the possibility of creating hypermedia with a minimum overhead caused by the remote use of the lesson. This is an objective that presented several problems, due to the richness of the programming environment. Therefore the prototype had to "cage" the authoring system's behaviour in order to transmit "codes" to the listening computers, and above all to make the creation of hypermedia simpler, thus avoiding complication of socket programming. Some technical details regarding network traffic are also interesting. The lessons currently present on the Internet suffer obvious limitations with regards the use of graphics and multimedia aspects, such as audio, video, animations etc. These must be necessarily reduced or even left out, in order to lighten the download of Html pages. Our approach eliminates this problem as the teacher's lesson and that of the student both contain the necessary material, and all the didactic material is already with the student when the lesson starts.
The prototype architecture is based on Booknet, a library of functions created by us which provide communication between different Toolbook applications distributed on the Internet through the implementation of a propriety communication protocol that makes use of TCP/IP as a transmission instrument. At the moment there is no overlap of the ports used by the HTTP protocol and therefore conflicts with other Web based applications have not been encountered. In the future a more detailed study of the use of the UDP protocol is planned, which is more suitable for the problems of broadcasting but more insecure in the case of more "distributed" networks in respect to our tests. The experimentation with UDP gave us good results, but:

- we mainly worked in Intranet environments (Department or University networks),
- we must consider that transmission speed has never been our problem: as already mentioned, the transmission of heavy updating operations is translated into several tens of bytes.

In the current version of the prototype, Toolbook communicates with the Windows library that deals with TCP/IP management. Booknet is interposed between the two, and "assembles" specific packets containing data that can generally be classified into four categories:

- Toolbook objects involved in the next action;
- Actions to be carried out on those objects;
- The parameters for those actions
- The levels of security to be respected in carrying out operations of various types.

The actions are received by the remote Toolbook application and interpreted on the basis of the protocol agreed on in Booknet. The most common actions are:

- Actions regarding opening / closure / connection state / forced closure / timeout etc. between the participants, with priority assigned to the teacher;
- Transmission of codified identifications from the prototype (not the original identifications in Toolbook) of the objects to be displayed or hidden on the remote stations. This part of the project, which seems trivial, was instead an unexpected obstacle as it was necessary to "reinvent" a naming convention for the Toolbook objects (buttons, text fields, groups etc.) to give the prototype greater management flexibility and one which was compatible (as much as possible) with the needs of the user.
- The remote activation of scripts using a particular protocol, function now supported also by Java through the RMI (Remote Method Invocation).
- The sending of predefined or "on the fly" scripts to remote sites and their consequent remote execution.
- The creation of objects that were previously not present, the modification of their properties and their duplication on connected machines.
- The creation of remote objects that were not previously present and which will not be created on the teacher's computer (for example, the reply to a request of a student).

These two last actions represented the most difficult part, especially with regards the problems of security. The protocol also encapsulates service commands sent to the remote computers, the most important of which include:

- The problems of acknowledgement that certain operations require and qther do not (such as, for example, the request for connection or the sending of a command);
- The levels of operation synchrony, in order to create a defined level of synchrony or a classical transactional mechanism with Commit and Rollback operations.
- The levels of security required by the operation underway, especially in the presence of the transmission of commands to be executed remotely.

5. Conclusions and future development

This work presents an alternative approach to the traditional mechanism of Web-based distance learning. The prototype allows the development of multimedia lessons in which the student and teacher interact in real time, and in which the coherence of the lesson is managed by the teacher. This aspect represents a leap forward in quality in respect to the impossibility for many teachers to create an interactive system via Internet. At the moment many of the Web-based distance learning projects are created using HTML pages or through complex software created using Java. The development environment originated from a widespread multimedia authoring system that does not require any programming knowledge for the teacher. The teacher prepares his didactic material, decides the sequence of actions to carry out and enables the students at the moment of connection.

The future of the system lies in the creation of a co-operative didactic environment, which uses Internet as a transmission instrument, where the teacher and student can interact in a non hierarchized manner on dynamic didactic material, which may not necessarily be pre-constructed. Furthermore, the prototype can be integrated with interactive support instruments such as electronic whiteboards, which are very widespread in proprietary video-conferencing systems. What is new is the possibility of being able to use a rich and complete multimedia environment: if one thinks only of the possibility of creating links between materials on a shared whiteboard. Currently the necessity of compressing the data transmitted has not been considered. In the future should one want to create remote objects that are not present in the initial version, this alternative will be considered by combining it with streaming techniques which perform sufficiently well at the current state of the art and can be easily integrated by following the same approach as that used for the transmission of sound and pictures of the teacher.

As an immediate objective we have the raising of the role of co-operation with regards the student. He should, from simple user of interactive lessons, become an active part of the educational process and transform himself into the "constructor" of the lesson together with the teacher. In this case the lesson initially transmitted by the teacher would represent the raw material on which he would work with the student, creating that which, in our opinion, represents the most interesting prospect of didactic hypermedia, that is "learning by building"

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Application of Structured Databases on the World Wide Web to Collect and Disseminate Information

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Abstract: The Division of Research, Evaluation and Communication in the Directorate for Education and Human Resources at the National Science Foundation is using the web and structured databases to collect and disseminate information. This paper discribes how we are using web technology and structured databases why their integrated use is an important tool for our future.

Introduction

The National Science Foundation (NSF) was founded in 1952 to initiate and support basic scientific and engineering research, and science and engineering education programs at all levels on behalf of the Federal government. The divisions of the Directorate for Education and Human Resources (EHR) provide services to the elementary, secondary, undergraduate, and graduate science education and research communities, as well as, support systemic reform in State and local school districts.

The EHR Web Site was developed to facilitate two-way communication with grantees, researchers, parents, students, and educators. Information collected using the World Wide Web is stored in structured databases, and then shared with the education community at-large and EHR management. This paper will discuss how we are using web technology and structured databases to collect and disseminate information and why their integrated use is an important tool for our future.

Background

The Government Performance and Results Act (GPRA) of 1993 provides for the establishment of strategic planning and performance measurement in the Federal government. GPRA requires a Strategic Plan, an Annual Performance Plan containing measurable performance goals, and an Annual Performance Report stating achievements and comparing actual performance to specified goals. One of the purposes of GPRA is to improve service delivery and sharing of results by providing more objective information. The EHR Web Site and its related databases are an important tool for collecting and reporting outcome indicators necessary to prepare the Annual Performance Report.

Currently, we have developed three applications that use structured databases and web technology to collect and disseminate information. First, the Project Information Resource (PIR) application was developed for the Division of Undergraduate Education and uses forms to allow users to input, view, and modify data stored in

the database. The PIR application then publishes the information collected to HTML pages that can be viewed by the person providing the data and others querying the site using key words. Another application searches a database of funded projects using forms to query the database. A third application developed provided a secure, password protected, discussion bulletin board that saved and retrieved information posted by users. Also, we are redesigning the EHR Impact Database, the largest database we are responsible for, to allow web access and retrieval.

Technology Supporting the Applications

Our application server, Microsoft Windows NT 4.0 is a very cost effective solution for the large volumes of data and heavy web traffic on our site. The EHR Web Site averaged approximately 456,486 hits monthly, in 1997. The Windows NT is part of Microsoft's Internet Information Server (IIS) which we are using as the web server. IIS is acknowledged as one of the best web servers available. Also, it supports development software that can be used to produce systems that access databases through the World Wide Web (WWW). Microsoft SQL Server 6.5 is an RDMS that provides a clean interface for administering the database while providing advanced capabilities for future growth. Also, it integrates nicely into our server and IIS web server.

The software used to deploy our databases on the web is Active Server Pages (ASP). ASP allows the creation of more dynamic web pages by offering a large amount of client and server information not generally available with other CGI based scripting tools. Also, ASP allows us to employ Microsoft Active X Components within the ASP scripts that produce the HTML pages. Since ASP is server side scripting, it is not client browser dependent. This is very important for many of the small colleges and public school districts we serve that do not have the latest technology.

Active X Data Objects are integrated into ASP to provide flexibility and ease of use for server-side database access. One of the benefits of using the ASP software is that it is well integrated with our application server and web server and can be used for Rapid Application Development (RAD). Also, there is a large amount of third party Active X Objects available to enhance the HTML pages our clients see without incurring additional development costs.

Summary

Traditionally, information needed for project management was collected using paper or diskette surveys. These collections were usually conducted by outside contractors. Once, these data were received, someone still needed to input or load the data into a database. This process was costly and very labor intensive and of questionable data quality. With the use of the web and structured databases we have eliminated the costs of printing, and manual loading of the data, since, data are entered directly into the database by the person providing the information. Also, we and our clients have immediate access to the stored data. The use of the web and databases returns a very large cost savings for the Federal government.

Acknowledgments

EHR's web and database activities are supported by an in-house contract with Compuware Corporation. I would like to thank the development team for their continued support and dedication: Jeffery Graber, Senior Project Manager and Karim Soufi, Jennifer Randall, Cathy Schroeder, Kevin Adams, Gobinder Ghuman, David Engelkemier, Asad Soharabi, Systems Analysts.

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Agents for the Matching of Peer Tutors with Distance Learners

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Abstract: Distance Learning via Web-based media such as WebCT can leave students isolated from peer support. The *Cyber-Agent* system analyzes students' learning styles and measures academic performance. Using a formal model of the course's contents and of each student's state of knowledge and learning style, the system identifies students with matching needs and capabilities, and recruits them as peer tutors/tutees. Educational benefit is expected to accrue to both tutor and tutee. Pilot experiments are now underway at the University of Central Florida.

The Lonely Learner

As Internet-based distance learning courses proliferate, they present many new opportunities for students to take a more active part in their own learning. However, they simultaneously make it harder for students to strike up the natural peer relationships that develop when sitting in the same classroom. Such mutual support has been identified as a crucial factor for individual student achievement [Katz, 1995]. In small classes being mediated via on-line chat systems, faculty sometimes encourage the creation of small discussion circles that work on homework together or otherwise provide mutual help. As classes get larger the chances increase that students will never find such support teams, and that faculty or support staff will not be able to detect these isolated folks and lead them to one another. Also, in many cases, Internet-based classes are being taught to such large groups that little or no real-time interaction is provided. In these cases, students correspond with the professor or with an assistant via e-mail, and have essentially a "correspondence-course" experience. These learners are missing most or all of the potential advantage of peer-to-peer interaction.

A Match Made in Cyberspace

The authors, while considering the new affordances of distance learning (i.e. its advantages, rather than its limitations), realized that it might be possible to develop a system that is partially based on the concept behind an "intelligent tutoring system (ITS)." A classic ITS includes models of students' state of understanding of the subject matter, as well as modules embodying strategies for remedying deficits in knowledge or performance. The standard strategy was to provide missing knowledge as well as experiences (such as problems to solve) which exercised the students' knowledge and led them to understand the problematic concepts. A well-known success story is the Algebra Tutor [Anderson 1993].

Such tutors differed from the current project in two ways. First, they were focused on individual learning. The present project is based on the idea that a model of the entire class' state of knowledge can be built and maintained. Mini-quizzes, as well as the results of standard assignments and exams, would contribute toward a dynamically changing database of student profiles. Additional information about students' talents, learning styles, and educational background could be incorporated. Second, the developers of classic ITS assumed that the software's designers could develop effective strategies for remedying deficits when they were discovered. In the current experiment, we use human rather than artificial intelligence to address this problem. When the "Cyber-Agent", as we call it, detects a deficit on the part of a student (call him Andy) with respect to concept C, it searches its database for another student (Betty) who has recently mastered concept C. If Betty's

background information indicates that she would benefit from helping Andy across this rough spot, the two are placed in communication via e-mail and realtime internet-chat.

The Cyber-Agent system is being prototyped at the University of Central Florida, where an extensive program of Distance Learning is underway [UCF 1998]. Most of UCF's Distance Learning courses are based on WebCT [WebCT 1998], a Web-based instructional management system developed by the Computer Science Department at the University of British Columbia at Vancouver. Independent evaluations [Manitoba 1998] rate this tool as a very good one among those currently available. Most of the WebCT's information processing routines are based on HTML (HyperText Markup Language), CGI (Common Gateway Interface) and Perl scripts. Our Cyber-Agent development project follows a similar strategy and uses the same languages and environments.

The Cyber-Agent has several ways of presenting itself. In one version, a screen would be provided that runs alongside the WebCT window inside the Web browser, and supports a simulated form of server push. Thus the agent can offer real-time advice to individual participants during a WebCT session. Where no live chat sessions are used, a simpler asynchronous method – largely based on e-mail – can be used.

Initial Experiments

In the initial pilot experiments, the interactions are asynchronous. An introductory computer applications course which is taught via WebCT to business majors serves as the test environment. Approximately thirty students each are randomly assigned to Cyber-Agent and control groups. The lesson material concerns introductory concepts about databases. The conceptual dependency graph for the subject material contains approximately 25 nodes, providing a nontrivial precedence relationship while remaining of tractible size for pilot purposes.

Students in the experimental group are made aware of the Cyber-Agent's availability via e-mail. They are guided to take some additional on-line diagnostic quizzes (beyond those normally required in the course). For these extra quizzes, 80% of the credit is automatically granted, as an incentive to take the quizzes and a way of reducing student anxiety about the impact of the experiment on grades. The remaining 20% of the credit depends on the students' actual answers, so as to reward sincere effort and discourage random responses. The Cyber-Agent then determines which students need assistance, and sends e-mail to both students.

Once the pilot tests are concluded, a main experiment will take place in classes at the University of Central Florida involving 300 to 500 students in the fall of 1998 and spring of 1999. To keep the experiment within manageable size, about four weeks of a sixteen week course will serve as the focal subject matter. An additional week or two of prior subject matter will support the users' initial learning how to use the system.

The research proposal and pointers to future papers, can be accessed at [Morelos 1998].

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J-MUSE; The Development of Pronunciation CAI System Based on Japanese Speech Recognition Intensified to Detect Errors

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We developed Pronunciation CAI system [J-MUSE (the Multimedia System for Education in Japanese)] based Japanese speech recognition. J-MUSE is intended for foreign students at Waseda University. We analyzed their pronunciation errors and incorporated that result to J-MUSE. Thus, as error cases of words designed by teachers were produced automatically, it became possible to detect pronunciation errors exactly. J-MUSE detects Japanese pronunciation errors of learners as follows.

1. J-MUSE produces error cases. The kind of errors is nine and there are 1-3 patterns for each.
2. The learner pronounces the word presented by J-MUSE.
3. J-MUSE recognizes the sound of the learner.
4. J-MUSE detects pronunciation errors of the learners and gathers error information.
5. J-MUSE analyzes their errors and urges learners to learn pronunciations, which it judged they had a tendency to mistake.

In addition, We tried learning appropriate for individual abilities of learners by analyzing history.

Analysis of Java Client/Server and Web Programming Tools for Development of Educational Systems

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Abstract: This paper provides a thorough analysis of old and new programming tools for development of client/server programs, in particular Web based programs. The focus is on development of educational systems that use interactive shared workspaces, to provide portable and expandable solutions.

0. Introduction

Computers have been used in education for many years (Alessi & Trollip 1991; Colbourne & Cockerton-Turner 1989; Maurer & Tomek 1990; Ketinger 1991; Maurer 1988; Maurer & Tomek 1990, Norman 1996), however they have been mostly used in labs, rather than in classrooms. During last several years, various universities have introduced "electronic" classrooms, see for example (Mühlhäuser 1996, Müldner & Nicholl 1996, Shneiderman 1995) in which each student has access to her or his computer, either by using a mobile notebook computer (Wake Forest University 1997, Acadia University 1997) or using a stationary computer (North Carolina). In these classrooms, computers are usually networked allowing students to access the Internet.

Various organizations started to develop integrated educational systems which provide numerous facilities, including access to various kinds of information about courses, such as course descriptions, computerized course materials, discussion groups, chat rooms, on-line tests, etc. The most notable examples of these systems are ACME (ACME 1997) and WebCt (Goldberg 1996). Some software tools support specific disciplines; for example physics courses have benefited greatly from the use of computer based presentations to simulate experiments; see (Holmes & Porter 1996). However, most of the existing systems do not support collaborative and interactive sharing of tools. To support groups of people working towards a common goal, one could design computer-based systems that provide an interface to a shared workspace. Indeed, such systems have been extensively researched; see e.g. (Benford, 1994, and Grudin, 1994).

In this paper, we analyze various software techniques that can be used to develop educational systems, in particular to implement shared workspaces. Our main concern is a development of portable, expandable and maintainable software. We are also interested in efficiency issues; that is building systems that can stand a heavy load of interactive users. Our paper starts with a short description of relevant terms and provides references for those readers that would like to expand their understanding of these terms. We present a traditional approach that uses dynamic HTML pages generated by CGI scripts, and describe drawbacks of this approach. Next, we discuss an object-oriented approach to development of client/server programs, using Java; in particular development of distributed systems with the help of tools such as sockets, Remote Method Invocations (RMI), and Corba. We compare some traditional and new Web servers. Finally, we make some recommendations on which tools should be used for development of educational systems; in particular shared workspaces.

1. Client/Server Paradigm and the Web

A *centralized* application is an application which runs on a single machine. A *distributed* application can consist of a number of components located on several networked computers. For the latter type of an application, a *client* is a component of the application that makes requests to another component of the application, called a *server*. Note that a client and a server terms refer to a role that the software component plays rather than to the component itself; i.e. a client can request information from the server and then the server may ask a client for other information, at which time the server and the client roles are reversed. A useful example of this situation is a technique called *callback*, where a client who makes a request registers with the server, and thus the server can call back the client. When the server calls back the client, it becomes the client.

For each active software component there is a *process* that runs this component (in general, a process is a "program in execution"). For example, a client process runs the client component.

The well known example of a client/server application is any Web browser (such as Netscape) and a Web server (in the next section, we show how a Web browser and server communicate). Here, the roles of the client and server are fixed; the client Web browser always requests information from the Web server. For such systems, it makes sense to use a term a server computer; which is a computer running a server process. The HTML pages, see (HTML 1994), are stored on the Web server's computer and are downloaded to the client machine when requested by the Web browser.

For two or more processes to communicate and exchange information, there has to be some kind of a *protocol* which is followed. For example, users running a talk facility often put "o" (for: over) and the end of each message, and "oo" when they are to terminate the communication. While various distributed programming systems use user-defined ad-hoc protocols, the Web uses a standardized protocol, called HTTP, see (HTTP, 1998).

What is involved in client/server *interactions*? A client may request simply some data; for example a Web browser requests text, images, etc. from the Web server. Then, a client downloads these data and uses them, for example to display an image. This type of a client is often referred to as a *null* client; i.e. a client which does no processing. The client can be more active and request an executable program, which after being downloaded, will be executed on the client. For the Web, an applet is an example of an active client; when it appears in the HTML page, then it is downloaded from the Web server's computer and executed on the client's machine. Now, not only the information but also the execution is distributed, which also distributes a total *load* related to an application in question.

At this point it may be relevant to ask whether it is better to use standalone client applications or applets which reside in HTML Web pages? The major advantage of an applet is that most users have a Web browser already installed, and for various reasons they may be unwilling to download and install another application. Also, there is a lot of functionality provided by Web browsers, such as displaying pages that include text, graphics, etc., and this functionality would have to be implemented in user-defined applications. (Note, however, that new java beans may provide this functionality and be easily incorporated into existing applications.)

Another essential issue in a client/server paradigm is the *persistence* of information; when a process produces some data, is this data persistent that is saved when the process terminates? This question should be discussed in the context of security: fetching or saving data means accessing a local file system and this activity clearly creates a security risk. Other examples of such activities contacting any site other than the server's site. While the fixed server, such as a Web server is at a well-known location, a client may come from an unknown destination, and may disguise its identity or even be an impostor. The client may decide to trust no one, and reject any attempt to start the above activities, to trust a selected site, or to trust everybody. Some browsers, Netscape included, make this decision for the client and trust no one (although with some programming it is possible to change this). Other browsers, for example Hot Java, let you choose your trusted sites. The HTTP protocol is *stateless*; when one client interaction is terminated and the next one starts, the server doesn't know about the previous history. The only exception to this rule are the so called *cookies* which are usually short files written by the Web server to the client's machine (the client may be asked if she or he agrees to receiving a cookie and may decline it). Sometimes, Web pages include invisible information used to remember the previous state (used for example, when a client performs an on-line transaction and responds to

a series of questions). Therefore, a typical way of making data persistent is to save them on the server's computer; using Common Gateway Interface, CGI. Below, we describe this technique in details.

CGI involves programs that can be invoked by the Web server. Here, we consider one commonly used scenario that involves an invocation of a CGI program; using a POST request specified by the HTTP protocol. When a Web browser (client) submits a POST request (this request specifies a CGI program, for example P), the Web server executes P. Now, P may need some input data. The Web server makes arrangements so that P gets its input from the data that are also provided in the POST request. This way, a CGI program can process input data and write some results to the server, for example store information in a database. In a similar way, the Web server redirects the output from a CGI program; if P outputs any data, then this data is sent back to the browser. If this data is in HTML format then the browser will interpret them in standard way, that is it will display a page based on the HTML code. This technique can be used to create *dynamic* HTML pages that are created on the fly by the server; unlike static pages that are represented by files, stored on the Web server's side. Dynamic HTML pages are more interactive and useful for security reasons; the client won't be able to access these pages unless she or he starts at a place where a proper authentication can take place. On the other hand, creating dynamic HTML pages may significantly increase the load on the server (see the discussion below). Executing CGI programs is a special case of server-side includes; i.e. programs or scripts that are executed on the server as a result of a special HTML tag.

2. Load

In a distributed environment, with multiple clients and servers it is essential to consider *load balancing*: if all the work is done on the server then clients have to suffer from possibly long delays. In particular, for a single Web server and a number of Web browsers (clients), a Web server can be easily overloaded if the number of hits is too high. Most Web servers that are currently used handle CGI requests in an inefficient way, starting a new process to invoke every new CGI program. There are several possible solutions to problems described above: (1) One can use multiple servers and a specialized hardware which distributes client requests and maintains consistency between clients; see http: //www.zdnet.com/pcmag/features/loadbal/open.htm for details; (2) Load is distributed between clients and servers. This distribution has to take place at run-time, that is we need a dynamic load balancing; and (3) More efficient way of handling CGI programs is used, for example using servlets (see below).

3. Communication Techniques: Sockets

Any two processes running on two networked computers can communicate using sockets (here, we assume that a network uses the TCP/IP protocol). *Sockets* are communication end-points, see (Stevens, 1994). There are two kinds of sockets: stream sockets and datagram sockets. *Stream sockets* are called connection-oriented because their use resembles a telephone connection: one process (a server) has to listen for a connection and the other process (a client) uses the first process' location (an IP address), and a port number (an integer value) to connect to the server. Thus, an IP address is like the phone number of a switchboard and a port number is like an extension. Once a connection is established, both processes can exchange information in both directions until one of them decides to close the connection (thus, a server process is really a server only when communication is to be established; afterwards it can play both roles; the client's and the server's). Note that in this case, we don't really need to use callbacks; the server has an open line of communication with the client.

Data received over a socket connection can be interpreted by the receiving process as a request to perform some operation; this way a sending process can indirectly "invoke" this operation by the receiving process. Of course, both processes need to follow a certain protocol known to both of them, for example to verify whether or not the required operation has been successfully completed. Stream sockets are reliable, that is any errors are reported and data will be automatically retransmitted if necessary.

Besides stream sockets, there are also *datagram sockets*, for which the communication resembles sending a package (called a datagram) by mail: a client process sends data and provides the address (an IP

address and a port number), but no fixed communication link is established and the communication is not reliable, that is the package could be lost. Again, we don't need callbacks because a datagram contains a return address, i.e. an address of the sender, which can be used by the server to call back the client.

In the remainder of this paper, we will only discuss stream sockets and will refer to them simply as *sockets*. The *standard* Web server and the browser use sockets to communicate. The Web server is represented by a so-called daemon process (called an httpd, which stands for an HTTP daemon); i.e. a process which is used to accept requests on behalf of other programs, and then forward these requests to these programs (something like a telephone switching board). HTTPD listens on a selected port (usually port 80), and the Web client connects to this port. When a connection with the client is established, the daemon starts a separate process to service this client and returns to listening for further connections (to avoid an expense of starting a new process, the server may maintain a pool of available processes, and use any available process, and start a new process only if the pool is empty). For any component of an HTML page, such as an image, a separate socket connection is established in order to transfer this component. As we mentioned above, a standard security requirement is that a Web browser can only communicate with the Web server from which the communication originated, in particular it can only open socket connection with this server and not with any other computer. If the latter option is required, specialized servers are required (see below).

4. Choice of a Programming Paradigm and Language

Programs that implement an educational system are large and complex; therefore they should be developed following standard software engineering techniques, so that not only the code but also the design can be re-used (thus, the use of design patterns, see (Arnold and Gossling, 1998)). Therefore, it appears obvious that an object oriented approach is the only approach that is currently acceptable. Among various object oriented programming languages available, we recommend Java because of the following reasons. First, Java supports threads and also garbage collection, both centralized and distributed. Thus, the programmer does not have to worry about memory leaks; a major issue when using a language such as C++. Second, Java is architecture neutral. Third, Java is more than a programming language, it is a system that has a number of components and built-in techniques such as Java Beans (for more information, see (Javasoft, 98)). Finally, Java supports various communication and distribution techniques, and one does not have to resort to using foreign libraries. Java can be used to develop client applications, server applications and also CGI programs. Currently, most CGI programs are implemented in Perl, which is a low-level, interpreted, procedural language.

5. Techniques to Distribute Execution

Using sockets for remote execution is rather cumbersome because it requires designing a protocol and coding to this protocol. In addition, it is hard to design expandable protocols that would accommodate any future needs. There are two techniques which can be used to directly invoke remote actions: Remote Method Invocation (RMI); and Common Object Request Broker Architecture, CORBA. Below, we briefly describe each of these techniques.

RMI, see (Javasoft, 1998) is a technique specific to Java; i.e. it can be used if we have two machines running Java Virtual Machines (however, these machines may run different operating systems). A server process exports an implementation of an object, which may support a number of methods. A client process can invoke these methods. This, from the programmer's point of view a call ref.foo(arguments) looks the same no matter whether the object ref is on the client's machine, or it is on a remote machine. For the implementation of this technique, exported objects have to be known to a registry, and a dedicated daemon process, called a registry process, listens on a socket port (typically, port 1099). The client connects to this registry process and then remote invocations made by the client are executed on the server's machine. Callbacks are easy to implement when using RMI; but some browsers such as Netscape require additional coding to enable special permissions. Unfortunately, the RMI programmer doesn't know whether a remote object is really remote; i.e. stored on a different machine, or it happens to be stored on the local machine (in the same address space) and

must take extra precautions to compensate for the fact that RMI uses different modes of parameter transmission in these two cases; for details see (Brose and al., 1997).

Corba is an abstract specification, see (OMG, 1995) and its implementation (called *ORB*) provides a more general technique than RMI. Corba is language and operating system independent. Both, the client and the server program can be developed in any programming language, although Java seems to be the easiest to use and it is becoming more and more popular, see for example OrbixWeb, (OrbixWeb, 1997). Unfortunately, due to a very general scope, Corba programming is not easy. For example a Java programmer must additionally know details of mapping of a general specification language, called an IDL into Java, as well as many other technical details. Again, Corba can easily take advantage of callbacks, for an example see an implementation of a chat room in OrbixWeb, (OrbixWeb, 1997). Two machines running Corba use a protocol called IIOP (Internet Inter-ORB Protocol). It is possible that there will be future implementations of RMI on top of IIOP, which will allow the programmer to benefit both from the simplicity of Java programming and the power of Corba connectivity.

6. Special-purpose Servers

Specialized servers are basically daemon processes that can be used for various reasons. For example, they can be used to deal with security restrictions imposed by Web browsers. If a Web browser wants to establish a socket connection with the socket located on a machine M which is different from the Web server's machine W, then we need an additional server running on W. This *relay* server will accept socket communications on behalf of M, and then forward any messages to M (there are no restrictions on operations of the relay servers). Another type of a specialized server running on the same machine as the Web server can be used to provide various tasks for which a Web server was not designed for. For example, if you want to develop a live chat room which at any given time accepts no more than 10 users, or which accepts only registered users, you may wish to use a *gateway* server, which will accept requests from the client and process them, either rejecting them, or accepting them and handing them over to the Web server. Here, we assumed that a Web server can not be expanded by adding a new functionality. Finally, it may be useful to have a specialized relay server to perform other tasks, such as a communication with other servers (the so-called three tiers architecture, see (Symantec, 1998)). For example, Symantec Café implementation provides a server called dbAnywhere which supports a communication with data base servers, see below.

7. Persistent Information

As described above, a generally acceptable way of saving information is to save it on the server, because there are no restrictions on what the server can do with its files. The best way to save information is to use a commercial data base, such Access or Oracle. To write programs that access data bases in a portable manner independent of a particular database one could use Object Database Connectivity, ODBC. However, ODBC is written in various languages and it is not object oriented. The better solution is to use Java Database Connectivity, JDBC, which is a set of interfaces to either directly access database servers or provide a bridge to ODBC. If an application that uses JDBC is on the same machine as the database server then it can directly "talk" to this server; this is called a *two-tier architecture*. Often, it is useful to be able to have an application on one machine M and a database server on another machine D. This *three-tier architecture* is possible thanks to an intermediate server running on M and communicating with D, and this is how dbAnywhere has been implemented.

8. Expandability

Since it is rarely possible to write an application that will satisfy all current and future needs, we need to be able to expand our applications. One could rewrite the application, or even better use inheritance and proper design patterns to satisfy new needs and then restart this application. However, it is far better to dynamically

expand running applications, and any Java application can do this. As the first example, consider a small bootstrapping application that downloads code to perform a task (this code can be changed on the server when a new version becomes available). For instance, an HTML page may contain an icon representing an applet representing a discussion group. When the user clicks on this icon, the applet downloads the discussion group. Web applications can particularly benefit from dynamic expandability. A Java Web browser can access a new protocol and be unable to handle it; but with extendibility it could download the protocol handler from the server and from that point on will be able to understand this protocol (Hot Java Web browser is an example of such an application). A Java Web server, such as Sun's Web server of JigSaw can handle servlets, which are basically server-side applets (for more details see (Javasoft, 1998)). A running server can be expanded to provide new services to the clients by using servlets.

9. Summary and Recommendations

It is our opinion that no one should even consider writing large educational Web-based applications and using a traditional, old fashioned technology, that is old Web servers, CGI scripts written in Perl and a file system for persistent data. Instead, one should consistently use Java object oriented techniques to develop a system that consists of components whose behavior and distribution can be easily modified and expanded. In particular, we recommend servlets rather than CGI, servlets and RMI, or Corba rather than sockets, and Java servers rather then using ad-hoc user-defined specialized servers. In our example of a live chat room, changing the protocol or distribution technique will be easy to do with the recommended approach and very difficult to do with a traditional approach. For the same example, saving messages using JDBC is rather trivial, while saving them using a file system is error prone and almost impossible to modify. The cost of this approach is that you need programmers who are highly skilled and experienced in object oriented programming, but the benefit greatly outweighs the cost. The resulting software will be maintainable, portable and modifiable.

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Experiences from CSCW in Virtual Classrooms

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Abstract: The rapid development of modern information and communication technol o-gies has opened new possibilites to establish and deliver distance learning. In addition, the new learning paradigm based on cognitive learning theories can emphasise the quality of the learning process. The open learning environment that utilises modern communication and information technologies can be described to be a virtual organis a-tion. Virtual organisation is a construct that provides services to public by examining the potential clients and service providers and dynamically assigning services to the clients. This paper discusses of virtual organisations as a sturcture for virtual learning structures, such as virtual classrooms and virtual universities. As an example of virtual classroom a hypermedia course was implemented using computer supported collabor a-tive software (CSCW) and WWW. Finally, e xperiences from the course are presented.

I. INTRODUCTION

The rapid development of modern information and communication technologies has opened new possibilites to establish and deliver distance learning. In addition, the use of the new learning paradigm and open learning environments based on cognitive learning theories can emphasise the quality of the learning process. The open learning environment that utilises modern communication and information technologies can be characterised usig concept *virtual organisation*. Virtual organisation can be defined to be a construct that provides services (i.e. distance learning courses) to public by examining the potential clients and service providers and dynamically assigning services to the clients [Mowshowitz 1997].

Pori School of Technology and Economics is a network university in the sence that it is administered by two separate universities, namely Tampere University of Technology and Turku School of Economics. Our students have a strong background from work and after graduating they usually go back to their companies. This makes it natural to experiment with new ways to distribute courses and support studying at Pori School of Technology and Economics.

In this article we describe an experiment from a "Introduction to Hypermedia" course where computer supported collaborative work (CSCW) were used. The course was a part of a Finnish Open Technical University, AVOTEK [Avotek 1997]. AVOTEK could also be described as a virtual organisation.

Multisilta has earlier studied the learning of mathematics using hypermedia based learning environments [Multisilta 1996]. In general the experiences from such a learning environment were positive and the learning process were improved. In addition, hypermedia based learning environment motivated students more than normal classroom studying. Collis et. al. discusses the problems of using group-based project work in higher education and presents experiences from two courses that used Web-embedded shared workspaces [Collis et al. 1997].

From the technology point of view, Papandreou and Adamopoulos [Papandreou et al. 1997] has proposed a general framework for the application of distributed, broadband multimedia communication services for education and training. The framework is divided into four separate layers: infrastructure, distributed processing, groupware and application layer. Infrastructure layer consists of the computer system and network infrastructure. Distributed processing layer includes middleware, operating system and network interfaces. Groupware layer

implements the basic services (i.e. CSCW tools, electronic document system and WWW) for educational multimedia applications that belong to the application layer.

Virtual organisation seems to provide more abstract framework to characterise broadband multimedia communication services for education and training. In the next section we try to define the concept virtual learning constructs using the framework of the virtual organisation.

II. VIRTUAL LEARNING CONSTRUCTS

Virtual learning constructs can be considered to be open learning environments that use modern communication and information technologies to implement the environment. More generally, virtual learning constructs are virtual organisations. Virtual organisation can be defined to be a construct that provides services (i.e. distance learning courses) to public by examining the potential clients and service providers and dynamically assigning services to the clients [Mowshowitz 1997]. In case of distance learning virtual organisations can be realised as virtual universities and virtual classrooms. The implementation of virtual universities and virtual classrooms requires software that supports team work in computer networks.

The elements used in virtual universities constitutes of an ideal *network based learning environment*. In this section we try to describe network based learning environments from the theoretical point of view. Generally, learning environment is a collection of topics [Siviter & Brown 1992]. A topic is a collection of educational activities, such as reading a piece of text, looking a picture, playing with a computer-based interactive device or searching information from the library. The general definition of the learning environment is based on the concept of learning-by-doing [Lehtinen 1997].

More technical point of view to the network based learning environment is to list the elements (hardware, software, information and people) that are needed in the network based learning environment. In order to learn by doing educational activities it is nessessary that network based learning environment consists of learning material as hypertext, problem solving tools (i.e. cognitive tools [Jonassen 1992]), communication and collaboration tools and external information resources. The active persons in the learning environment are students, teachers, experts and authors of the learning material. A person can have multiple roles in the network at the same time. For example, the students can sometimes be also the authors of the learning material. The network based learning environment is outlined in [Fig. 1].

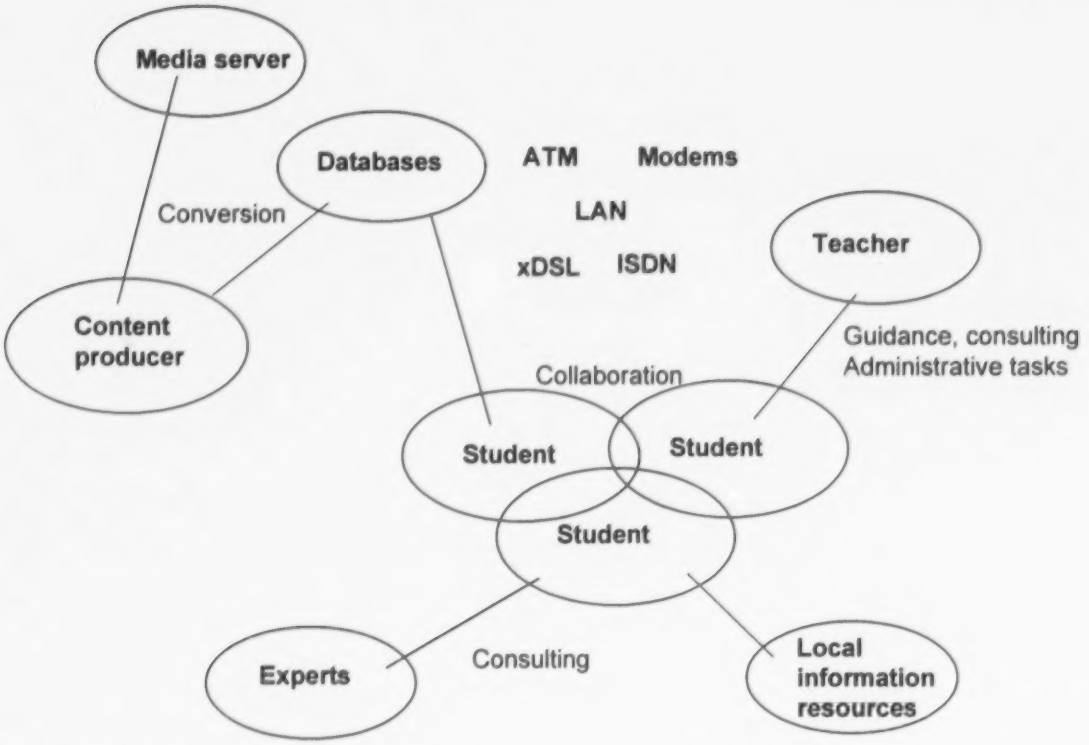

Figure 1: Network based learning environment.

An example of a cognitive tool can be a spreadsheet application that is used to solve a computational problem. By constructing a spreadsheet model the student is able to solve the problem. The construction and testing of the model is certainly a cognitive process.

Collaboration tools are tools that can be used by several students from different computers at the same time. Often a collaboration tool includes a shared workspace that can be graphics area or a word-processing document. The workspace can then be viewed and edited by several users at the same time. Examples of collaboration tools are shared whiteboard or shared calendar applications. Communication tools enable communication between the students and the teacher. The communication can be off-line (email) or on-line (audio- and video-conferencing applications). Also, the communication can be one-to-one, one-to-many, or many-to-many. Evaluation of several conferencing applications are presented in [Juell et al. 1996] and [Duran & Sauer 1997].

The type of the network conncetions in the user side and in the server side can considerably limit the type of the activities that can be delivered to the remote student. For example, the use of video material may be impossible in slow modem connections but acceptable in ISDN (Integrated Services Digital Network) connections. Furthermore, in the near future we will have broadband networks to home by using ADSL (Asymmetric Digital Subscriber Line) technologies. They enable real-time, broadcast quality video material to be distributed to home users using old copper cables.

There has not yet been many implementations of learning environments that can be described as a network based. For example, the survey of learning environments in mathematics in [Multisilta 1996] shows that many learning environments do not yet utilise communication technologies. The network based learning environments differ from local learning environments in the fact that in network based learning environments the information is loaded at least partly from the network and not from the local hard disk or CD-ROM. This fact must be remembered when desigining and implementing network based learning environments. Especially, the

three key factors for using networked information are: availability, reliability and usability. To some extent virtual universities solve these problems by providing reliable and usable information resources that are validated and revieved by the content specialists.

Availability of the Information

Availability means that information may be available and still be impossible to use. This is probably due to slow connections that prevent the use of large video materials. If it takes several minutes to load a one minute video sequense then it can be said that the material is not really available.

Reliability of the Information

Reliability means how to be sure about the correctness of the information. Partly this problem is solved when the material is delivered thru virtual university that validates the material. Also, the material from well-know organisations such as big publishers or research institutes may be considered to at least as reliable as their printed versions.

Usability of the Information

The problem of finding information from WWW has been well-known since the beginning of the WWW-age. Currently, there are many search engines available that examine the contents of WWW-sites and catalog this information to their databases. Searching these databases can give first hand knowledge of meaningful information sources. However, many of the search "hits" may be rubbish or the referrein page does not anymore exist. So still the question remains that how to find relevant information and especially how to find information that can be understood with my backgound knowledge and skills.

III. EXPERIENCES USING CSCW

Pori School of Technology and Economics has developed a course "Introduction to Hypermedia" to be distributed using WWW. The course were delivered as a part of Finnish Virtual Open University of Technology - project (e.g. AVOTEK in Finnish) [Karjalainen & Hiltunen 1997]. The AVOTEK is the first step in building a virtual university in Finland and "Introduction to Hypermedia" course can be described as a virtual classroom inside the virtual university. The course was implemented using software called BSCW (Basic Support for Collaborative Work, [BSCW 1997]). The course were delivered first time during autumn -97. There were 10 persons that took the course. On summer -98 the course was done again wit more than 90 students.

The course was started by informing the students by email. In response to the email the students registered themselves to the BSCW. Each week the teacher created a short description of the topic of the week and included reference material (i.e. verified links). The description were posted to the BSCW. In addition, the teacher created exercises that the students processed every week.

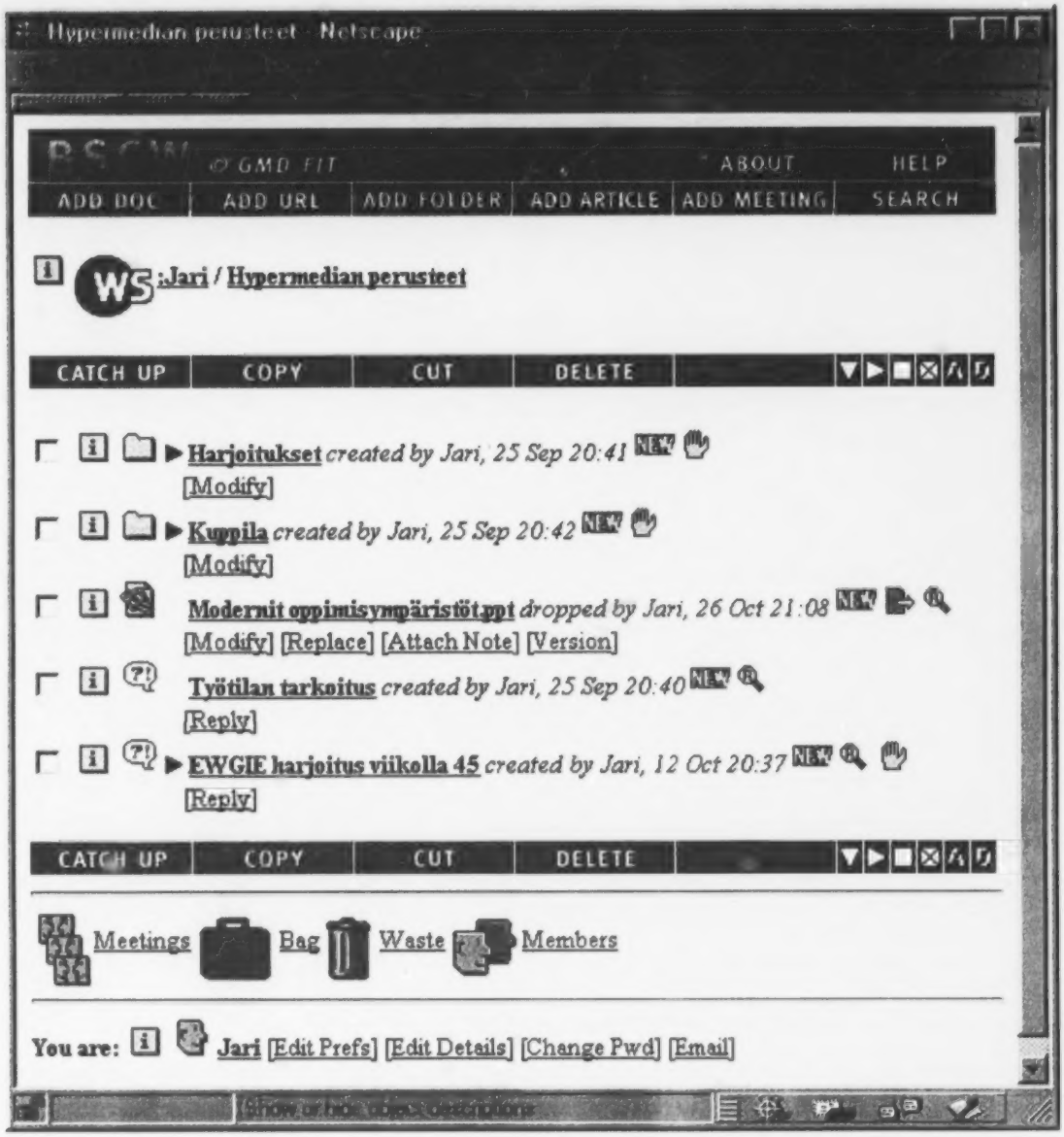

Figure 2: BSCW software for computer-supported collaborative work.

The experiences from the first course were encouraging. In general, the students were highly motivated on learning using modern learning environment. The students had a good knowledge on using computers and WWW. This is why it was possible to start to without first teaching to the students how to use the tools (i.e. computer, Windows 95 and WWW).

During the learning experiments it was noticed that different forms of interactivity needs to be studied more carefully. Some student groups succeeded in using CSCW tools in the learning while others had a lot of difficulties. For example, one exercise during the course was to study one of the makers of the hypertext history. The persons to be studied were Vannever Bush, Dough Engelbart, Ted Nelson and Tim Berners-Lee. The group

BEST COPY AVAILABLE

who studied Ted Nelson did a web-page[1] where they included a picture of Ted borrowed from Ted's own home page[2]. In his home-page, Ted Nelson encourages people to use his picture in other web pages but leave a note (transcopyright). Sometimes Ted checks the transcopyrighted pages. The gropumembers were extremely happy when Ted visited their Ted Nelson page and emailed his thanks to them. This way the group learned the history of the hypertext, the concept of transcopyright, the making of the web page using CSCW and even got a great reward.

Another experiment with CSCW has been carried out with health care experts participating in continuing education. The aim of this course was to learn to use modern communication technologies as a part of their every day work. Groups participating from different hospitals and different departments did a project work using WWW, BSCW and email. The topics of the project work were health care task descriptions and descriptions of healt care procedures at home and self-medicin.

IV. CONCLUSION

In this paper, we charasterised distance learning as a virtual organisation i.e. virtual classroom. Technologies to be used at virtual classrooms include videoconferencing and computer-supported collaborative work software. These technologies were used in teaching students in multimedia course and health care experts in continuing education. So far the feedback has been good.

During the learning experiments it was noticed that different forms of interactivity needs to be studied more carefully. Some student groups succeeded in using CSCW tools in the learning while others had a lot of difficulties.

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[1] http://www.dlc.fi/%7eazaria/hyper/index.html

[2] http://www.sfc.keio.ac.jp/~ted/index.html

Different Aspects on the Use of the Internet as an Educational Tool

-A case study of possibilities to schools by the Educational Department of Helsinki

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One of the central decisions made by the Education Committee and the management of the Education System during the first half of the decade in Finland, was to choose information technology (IT) as one of the key areas of the current educational strategy. When the conditions for using IT in teaching were surveyed and compared in the schools of Helsinki, the need for great improvement was generally acknowledged. Learning IT skills already in comprehensive school is essential for students and school children, if they want to succeed in society. After all, they are the citizens of the next millennium.

In the spring of 1995, the Education Department submitted the network plan of the Education System to the Board of Directors for their approval. Included were actions that could be taken to enhance the possibilities for the schools and colleges in Helsinki to apply IT to teaching. During the preparation of the budget for 1996, the over-all expenditure for the whole project was estimated to come up to *fim* 170 millior (US$ 33 million/ ECU 30 million) by the end of the decade. The Information Technology Project was launched in the autumn of 1995.

In general education this means that education should provide every pupil with basic IT skills: the ability to obtain information, data processing and telecommunications- which they will need in further studies. In terms of equipment this means that there should be at least one Personal Computer per six students in the school and every student should have access to at least one hour of computer based studies per day.

The Teachers In-Service Training Program has played a crucial part in the project. Hardware is nothing but hardware until you know how to turn it into something useful. Now there are courses constantly being carried out. One cornerstone for the project has been that the teachers should be able to re-train themselves during regular working hours. In the beginning these courses were mainly IT-basics. As the skill-level of the teachers has improved the need for subject-specific training has won more and more ground in the re-training program.

We are provided with very high technology in our schools, but can we really use it to improve our teaching methods? As the teacher's role is fundamentally changed we have to be smart enough to keep our efforts at a level that we can master. Can we keep on taking progressive steps to create a level of understanding, or are we driven to impress our neighbors by advancing too hastily?

Helsinki, being the capital of Finland, also has a responsibility to guarantee the highest possible level of education. This is also true for the official minority languages of which Swedish is the biggest – with approximately 6% of the population of Helsinki. The small society of the Swedish community has specific needs. The Finnish community is a lot larger with larger amounts of schools and a lot more students. The information obtainable in Swedish or Finnish is limited. The material on the Internet is primarily English. The senior high school students have a capability of understanding and using the English data, however the problem on this level is the lack of cultural identity-strengthening factors.

The new learning tools that the Education channel provides gives the small community the possibility of using IT as a complementary asset in education. The programs produced are readily available, and are programs that are not translated from English. These are mainly produced by Swedish speaking Finns and therefore have a cultural identity-strengthening role. The usage and pedagogical ideas will be tested and developed by the schools this spring and the following semesters.

One significant issue we have learned so far is the fact that we need to reorganise our pedagogical methods. Evaluation for instance has always played an important part of every learning process. As we are including the Internet to our education we get an overwhelming flow of information. How can we measure what we actually learn from this information? When a student passes in their essay, how can we tell what they have written themselves, what they have learned in the process? How can you erase the doubt that everything is assembled from what was found on different WebPages? How can you as a teacher keep track of what your class actually learns in the process? With computers we can do many things simultaneously, saving more time compared to when we where without computers. Can we now also learn much faster than before?

These and many more big questions arise when we talk about IT in education. The main issue at hand, is that when we actually realise that the use of computers doesn't exclude traditional teaching methods, then we can solve even greater problems than the ones previously mentioned. Let's not re-invent the wheel. We need to master basic skills in order to have some use of our computers. As a saying in the staffroom goes: "Do not fight for your existence. A machine can never replace the magic that occurs when two individuals meet. But, when you meet and work together with the help of a machine, miracles will happen."

Improvement in education does not occur only because we buy a new computer. It is essential that we take some time off in order to think of what, how, and why we should include IT in our education.

In Helsinki we like to think that there will not be very much progress if we exclude IT from education. We are therefore very optimistic about the future since there has already been great improvement in our schools.

Here is a short glance of what is going on in Helsinki. Today we are in the middle of a process that when completed will leave the City with an annual inheritance of about *fim* 30-40 million in maintenance costs. Is it worth it? Yes we think it is. Our project is one of the largest in Europe today. We are constantly seeking out a global success which is beneficial to all – through partnerships with countries around the world.

Convivial Cybernetics or the Borg

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Abstract: The author observes two paths ahead. Both lead to the unprecedented integration of cybernetics and human organization, a cyborganization. One path through consensual cybernetics supports self-organization around shared goals leading to utopian conviviality. The other path through cybernetic optimization of performance leads to a loss of personal freedom and dignity. What we see when we look into the future has implications for our current choices and the future we create. The value of our predictions is not their accuracy but their ability to mobilize human intention and effort in the creation of a desirable and sustainable future.

Cyborganizing

The noun is cyborganization the verb is cyborganizing. New words are needed to talk about new realities.

cybernetics	**organ**ism	organ**izing**
n. The study of human control functions and of mechanical and electric systems designed to replace them.	n. A form of life composed of mutually dependent parts that maintain various vital processes. Any organized body or system conceived of as analoguous to a living being: the governmental organism. Any complex thing or system having properties and functions determined by the character of the whole as well as of the parts and by the relations of the parts to the whole.	vb, 1. to cause to develop an organic structure. The act or process of organizing. To unify into a coordinated functioning whole: put in readiness for coherent or cooperative action. To set up an administrative and functional structure: provide with or establish as an organization.
cyb	**organ**	**izing**

Cyborganizing

Believing as Willing

What follows are beliefs about the future, a future that cannot be proven. Believing is as much an act of willing as an act of knowing. Believing in a desirable future can create a future that is desirable. The future can be willed into existence through believing in it, sharing belief about it in compelling ways and taking action. When groups of people share beliefs a very special energy is activated. This shared believing, shared willing can create the future. Our future is the sum total of our collective beliefs about it.

Let's believe that we will create a future in which our human experience will be enhanced by our intimacy with one another through our intimacy with technology. If we fear a gray Borg future, let's take charge of our beliefs, our willing. We are at choice. We are hurtling along an information highway toward the future. If we close our eyes at the horror of the future we see, we will inevitably make that horror our reality. With steady gaze, we can take charge of the virtual highway along which we travel and create a future with beautiful new horizons and destinations not yet imagined.

What Matters?

There seems to be abundant evidence that natural systems harness energy, organize matter, develop and endure because they adapt to their environments. If a system is able to adapt to changes in its environment it has a significantly greater capacity for enduring over time. Individual humans are pretty adaptable, but require a community in which their individuality is defined. We call certain forms of human community *organizations*. Organizations take the potential for adaptation to a whole new level. Incorporated within societies of law, organizations or corporations are granted the rights of persons. They own property, and enter into contracts. Corporations can avoid the inevitable scourge of individual humans, death. They do an effective job of avoiding the other inevitability, taxes. Corporations are granted this perpetuity as part of a public trust in which they commit to serve the common good. The fact of evolution is argued by some. Others accepting evolution debate its exact mechanisms. No one debates that organizations have the ability to evolve. What they evolve into depends on the collective belief of their human members.

Some say that evolution is the universe learning by trial and error. Teilhard de Chardin a deceased, Jesuit priest, paleontologist, mystic claims that "complexification" is the inevitable results of that learning. He believed that as the universe evolves it becomes more and more complex. Further that this complexity eventually supports self-reflexive consciousness, as in the phenomena, man. He saw this complexity continuing to evolve through the noosphere, a gossamer web of human consciousness into a supra organism. Organizations survive because they support learning and knowing at the organization level. Remembering history gives us cumulative wisdom, a consensus with our past. Striking a dynamic balance between freedom and constraint organizations can achieve goals even while being open to reconfiguring the way they organize in response to the environment and to the internal consensus of the individuals that give them energy. Hopefully integrating technology and human potential will create a future that is truly desirable, this implies there will be a correlation between individual desire and available choices. A future in which no one works is inherently just as repugnant as a world in which people are forced to work in oppressive environments. If we believe it is possible we can create a future in which we will be able to engage in meaningful activity in a more or less seamless pattern of work and leisure.

The Cyborgs of science fiction are integrations of cybernetic mechanisms and organic systems. The Borg of Star Trek science fiction is the communal expression of cyborgs. An emerging reality and not science fiction, cyborganizations are the integration of human and cybernetic systems. One of the fundamental differences about our two possible futures the one of convivial cybernetics and the other of the Borg is a difference in approach to choice. The Borg moves along a path of "either or" while convivial cybernetics moves along a path of "both and". Optimizing diversity is a fundamental strength of the adaptive successful organization that leads to convivial cybernetics. Stifling diversity can lead to a stable organization but it also leads to the Borg.

The two paths leading into the cyborganization of future are not crossroads. Our choice is not between one path and the other. Both paths run through each human heart. We can make a commitment to consensual cybernetics that leads to performance without the loss of freedom and dignity, to a convivial cybernetics, sooner rather than later. Inevitably the future of the universe is one of growing complexification, interdependence, and consciousness. Our future is the future of a cybernetic collective. This cybernetic collective can say with conviction, "Resistance is futile." "We will assimilate." But a desirable and sustainable future is ours only if we choose it every day.

Some refer to our planet Earth as Gaia, a single living organism. While we are at choice, our choice is to be or not to be part of that living organism. Let's choose to be intimately involved in the quickening self-reflective consciousness of a living planet. Now's our chance, and maybe our only chance. We can awaken slumbering Gaia from her vegetative sleep. With our help Gaia will shake the slumber of eons from her collective mind and Gaia the living planet will join the family of living planets at play in the universe.

A Intranet-based CAI System for Language Education

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Recently, many studies have been reported on the applications to the educational field. We are also using the CAL software developed in our laboratory for language education. But the problem that the learners can not see the blackboard, because the classroom is too large. So we have developed the CAI system which used the Intranet effectively. In this system, we are using sound, picture share, test support, and student attendance management. Each teacher and student's display can be used as a blackboard. Then the teacher can write the sample text to all the clients. We evaluated this system by actually using it in a language class. After initial difficulties, this system was well received by both teacher and students. In particularly, the teacher recognized that this system was helpful for his lecture, and the students were useful to study. After this, we have developed this system for distance learning.

Some Recommendations on Building Proxy Caching Service

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Abstract: In this paper, we present our research on WWW caching proxies. We drew some key conclusions on the service properties and caching policies, according to the results of our analysis of caching proxies. These conclusions include our recommendations on cache configuration and illustrate how choosing cache scenarios depends on the different requirements requested by the cache manager and different network conditions.

1. Introduction

In response to the growing demand for web caching services, much research has been made on WWW caching and replications. Today, there are several technological possibilities available to support caching service. However, as research continues to improve these technologies, there has not been enough analysis to provide recommendations for making a concrete choice that depends on the particular interest and conditions of cache exploitation.

In this paper we will look at some of the possible variants for building a cache system, compare their performances under different conditions, and recommend the best options for several typical cases of cache usage requirements.

We will review the main functionalities required from caching proxies and concentrate on the protocols for their support in the Section 2. Section 3 is dedicated to the configuration policy for caching proxies; we will analyze criteria and make recommendations on it. In section 4 we discuss the ideas on the policy of caching. Possible areas for future research are highlighted in the Section 5, and our conclusions are presented in the Section 6.

2. Web Caching Review

2.1. Proxy Caching

The advantages of proxy caching are well known; the most valuable are the reduction of Internet traffic and the decrease of response time for WWW users. The most important functions that are required from modern caching proxies involve support for hierarchical caches, distributed caching, and the auto pre-fetching of the objects, which have expired in the cache or active caching. Hierarchical caches make possible for a downstream proxy to forward requests to upstream proxies rather than to the Internet. Upstream proxies serve a large number of users and have a better probability for finding a WWW content for the request. Hierarchical routing of the requests should be implemented for this function. Distributed caching requires distributed routing to be done between proxy servers, which work together as a distributed cache; load balancing, fault tolerance and scalability should be supported for this function. Active caching can work with different algorithms. For example [Bestavros & Cunha, 1996] and [Almeida et al. 1996] specify temporal locality of reference and geographical locality of reference. The former implies that recently accessed objects are likely to be accessed in the future, the latter, implies that an object accessed by a client is likely to be accessed again in the future by "nearby" clients. Thus it may be reasonable to pre-fetch the most popular and most recently accessed files among those which are in the cache and have expired.

Today, among the publicly and commercially available caching proxies, Microsoft Proxy Server 2.0 includes most of the described functions. We considered three different caching proxy software products: Microsoft Proxy Server, Netscape Proxy Server and Process Software Purveyor. We compared the differences in their performances, including cache response time for cached objects. Netscape Proxy performed significantly worse for small objects (up to 200 KBytes). Process Software Purveyor with a good average performance, showed irregular service behavior. It was able to deliver about 40% of cached objects in very short time, while the others

had an almost constant delay in service time. It can be related with a strategy for memory allocation or object retrieval from cache storage. In conclusion, Microsoft Proxy Server 2.0 was chosen for a basis for proxy caching service. It uses Cache Array Routing Protocol (CARP) [Microsoft 1997] for communication between different proxy servers.

2.2. CARP

CARP was designed as a potential replacement for the Internet Cache Protocol (ICP) [Wessels & Claffy, 1997a], [Wessels & Claffy, 1997b], the existing Internet standard for caching protocol, currently implemented in Harvest and Squid proxy cache packages. With CARP it became possible to create arrays of proxy servers, which work like a single virtual proxy server cache. According to [Microsoft 1997], two powerful benefits of CARP are:

- CARP uses hash-based routing to provide a deterministic request resolution path. Because of this there is none of the query messaging between proxy servers that is found with ICP, which creates a heavier congestion of queries as the number of servers increases.
- CARP eliminates the duplication of contents that otherwise occurs on an array of proxy servers. With an ICP network, an array of five proxy servers can rapidly evolve into essentially duplicate caches of the most frequently requested URLs. The hash-based routing of CARP keeps this from happening, allowing all five proxy servers to exist as a single logical cache. The result is a faster response to requests and a more efficient use of server resources.

ICP was designed with hierarchical cache in mind, and assumes that at any given single point in the hierarchy only one or two ICP servers as maximum are needed. CARP also supports hierarchical routing, but in addition it provides the possibility to build a large cache array (several machines acting as a single point cache) at one of the levels of hierarchy.

CARP makes it possible to plug additional servers into the cache array or subtract a server from the array without massive reconfigurations and without significant cache reassigning. Its cache-management features provide both load balancing and fault tolerance. CARP 1.0 was submitted as an Internet draft to the IETF.

3. Caching Proxy Configuration Policy

3.1. Caching Arrays Versus Stand-alone Caching Proxies

The benefits of CARP are mainly in its cache array management functions. But the key question is: "When does it become reasonable to configure cache array instead of using a stand-alone proxy caching server?" We made a set of measurements to find an answer.

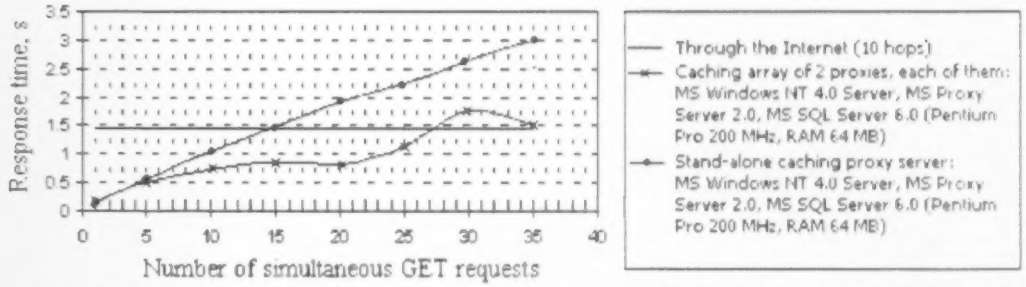

Figure 1: Average response time for the files of 100 KBytes, depending on number of simultaneous GET requests.

Different configurations of caches were tested under different loads, particularly the value of response time for the request served from the cache was measured for files of constant size under different server loads. [Fig. 1] represents the dependance of response time for the files of 100 KBytes on the number of simultaneous HTTP GET requests. To simulate certain number of simultaneous GET requests, we used a correspondent to it number of processes, which were running in parallel on one client machine and were sending requests to the cache. Each

of these processes was generating GET requests consequently (e.g. a process sends a request after a previous request was served from the cache). The client machine had the following configuration: Intel Pentium-II 266 MHz, RAM 64 MB, MS Windows NT 4.0 Server. In [Fig. 1] one curve corresponds to the stand-alone proxy server (Intel Pentium-Pro 200 MHz, RAM 64 MB, MS Windows NT 4.0 Server configured with MS Proxy Server 2.0 and MS SQL Server 6.0). Another curve corresponds to the cache array of two proxy servers (each of them Intel Pentium-Pro 200 MHz, RAM 64 MB, MS Windows NT 4.0 Server configured with MS Proxy Server 2.0 and MS SQL Server 6.0). And as a reference point the value of response time when the request was served from the Internet is presented; it was equal to 1.47 seconds.

In order to obtain a natural estimation of cache scalability from this data, we introduced a simple correspondence between the number of simultaneous HTTP GET requests and the number of cache users who browse the WWW at the same time. It was concluded from the statistics of our cache usage that an average user makes $R=4.433$ GET requests per minute, we define R as the *user rate*. From our measurements we got the dependance of response time for the files of 100 KBytes on a number of simultaneous HTTP GET requests. If m is a number of simultaneous GET requests and $t(m)$ is an average response time corresponding to m [Fig. 1], then $R^*(m)=m/t(m)$ is the *cache service rate*. Then the number of real cache users who browse the WWW at the same time can be approximately equal to the ratio of the *cache service rate* over the *user rate*.

$$N_m = \frac{R_m^*}{R} = \frac{m}{t_m R}$$

[Fig. 2] shows the same dependance as [Fig. 1] but on $N(m)$.

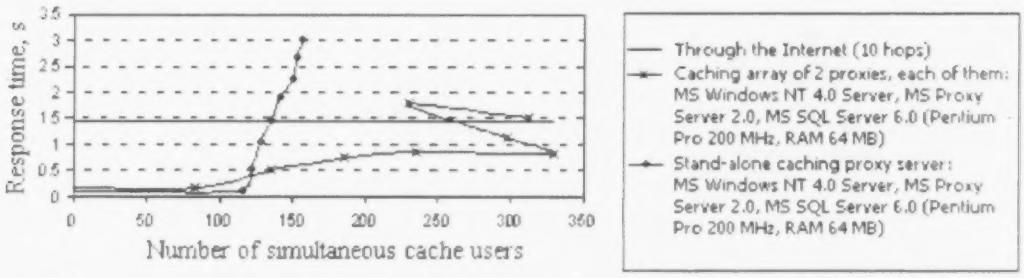

Figure 2: Average response time for the files of 100 KBytes, depending on number of simultaneous GET users.

From these results we can conclude that unless the number of simultaneous cache users is bigger than 100, users requests most probably will not influence each other's response time. Also we see that for the cache points where approximately up to 120 people use cache in the same time it is rational to build a caching service on only one stand-alone server, which could however be one of the levels in hierarchical tree of caching proxies. 120 users can be taken as an edge value. Until this value it is not reasonable to use CARP caching arrays since additional load related to computation of routing decision among array members is not compensated by the load, which users create for stand-alone configuration. Only for locations where more users accesses the WWW at the same time it is better to have arrays running with CARP, configured from two or more caching proxies. And the more servers that would form an array, the better the scalability one could get in this case. Since CARP assumes queryless caching, it avoids an increase of computing overhead while increasing the number of array members.

3.2. Logging to a Database

Logging to the MS SQL Server databases is possible option for keeping caching proxy logs. The decision on where and how to store proxy logs depends on many factors, mainly on the further actions, which are supposed to be done with logs. But in the case where it is decided to use logging to the MS SQL Server database, consideration should be given to the fact that the SQL Server by itself requires some system resources. According to our results, it is always preferable to keep the MS SQL Server database on a separate machine; otherwise the scalability of the caching proxy will be significantly lower.

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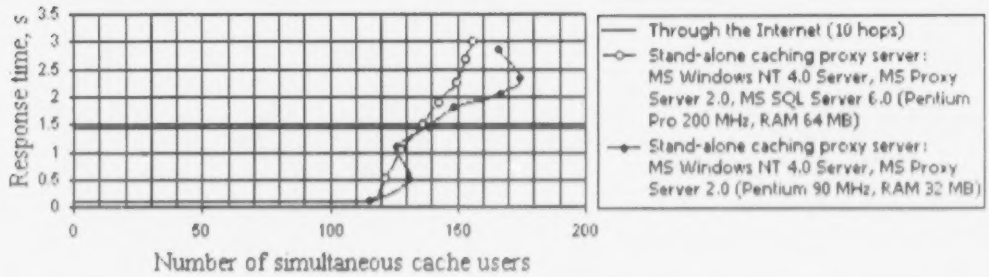

Figure 3: Average response time for the files of 100 KBytes, depending on number of simultaneous GET users; comparison for two different server configurations.

[Fig. 3] shows the comparison for two servers configured as stand-alone caching proxies. The first is Intel Pentium-Pro 200 MHz, RAM 64 MB, Windows NT 4.0 Server configured with MS Proxy Server 2.0 and MS SQL Server 6.0, which keeps its proxy logs in its SQL Server database. The second is Intel Pentium 90 MHz, RAM 32MB, Windows NT 4.0 Server configured with MS Proxy Server 2.0; it keeps its proxy logs in text file.

4. Caching Policy

4.1. Caching Versus Replication

In addition to traditional proxy caching, one could consider complete replication of the Internet WWW site to local storage for off-line browsing. This makes sense only for the sites that are not updated frequently, otherwise it would produce huge amounts of traffic; and taking into account that some parts of the context could be never requested by users does not sound reasonable [Baentsch et al. 1997]. The choice between caching and replication depends on several criteria. A set of experiments was performed in order to estimate their significance and to decide on the kind of service, that would be preferable to use.

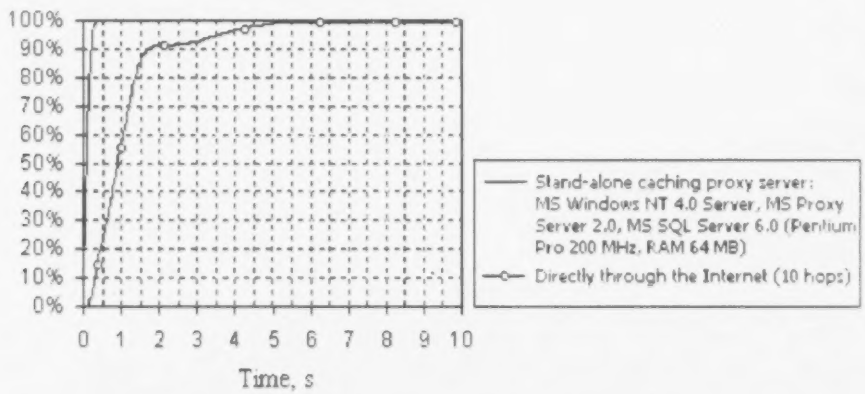

Figure 4: Download percentage for files up to 100KBytes.

Two sets of measurements were made for the two cases of download of WWW context. In the first case (I) files were downloaded from the Internet WWW server (10 hops away). In the second case (II) files were previously cached while making initial request through the proxy and were requested once again, in such a manner were downloaded from proxy cache via 10 Mbits/s LAN. [Fig. 4] and [Fig. 5] represent percentage of files downloaded with different response time values. [Fig. 6] shows the statistical data for the speed of the file download depending on the size of file. This statistics shows that about 2% of requests for relatively big files (of the size distributed randomly between 0 and 1E6 bytes) were not actually cached during initial request and service speed was slowed down to the speed of the Internet. This corresponds to the lowest peaks on the [Fig. 6].

This can happen because connection to Internet server can be broken during download of big file due to the network congestion.

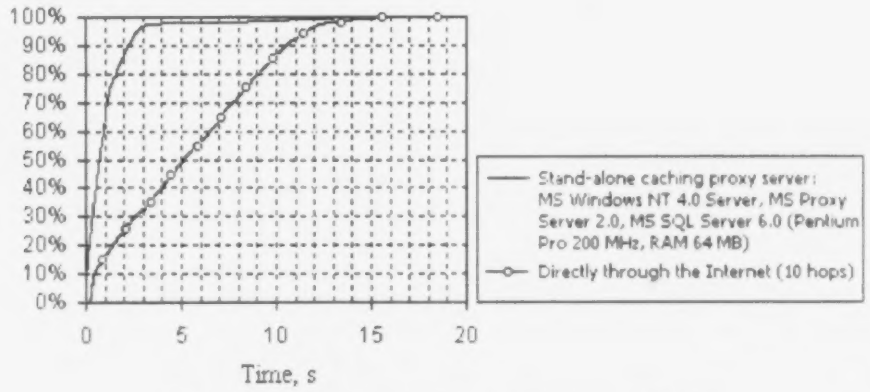

Figure 5: Download percentage for files up to 1MBytes.

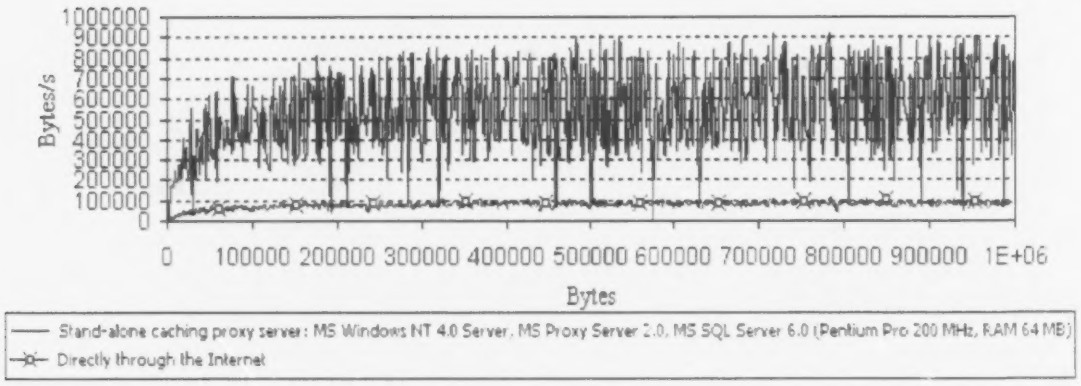

Figure 6: Speed of download depending on size of object.

Considering this statistics we can make difference between two kinds of WWW sites. The sites, which contain big amount of large files, form the first group. These are mainly sites containing a lot of graphics, such as, for example, Nicholas Roerich Museum (*http://www.roerich.org/*). In the second group there are "average" sites, most pages of which have total size of all objects of about 200 KBytes or less. The first group is primary target for replication, since broken connection, which can potentially occur while caching, could force user to wait more than 15 seconds until he/she gets just one of the objects on a page from the Internet. It is not reasonable to make replication of sites from the second group unless the site is accessible only through slow link (e.g. 10KBytes/s or less; for the reference WAN speeds are estimated [Microsoft 1997] typically 64Kbits/s – 1.5 Mbits/s). Therefore it is preferable to use caching for this group of sites. One shall note once again that all these suggestions apply only to the sites, which are not updated frequently, others shall not be replicated.

4.2. Updates Policy

As mentioned earlier, one of the two major advantages of caching proxies is the decrease of Internet traffic. This point became less valid after active caching was introduced. Some caching software products are able to automatically update files that are near to expiration or have already expired. The expiration time for an object normally should be provided by the WWW server, however this option is not used very often. Either caching proxies take original expiration time from the WWW server or if it was not provided, a caching proxy may set

this parameter for its cache according to the object's lifetime taken from the date of last modification of the object.

The proxy administrator can manage the amount of files updated and the frequency of updates. The main criterion, which should be considered here, is the number of proxy users. The value of geographical locality of reference [Bestavros & Cunha, 1996] becomes smaller and the number of objects becomes bigger while the number of users increases. Hence when the number of users increases it is reasonable to reduce at first the amount of files updated and afterwards consider the reduction in update frequency.

5. Future Research

Our conclusions could be useful recommendations for decisions in cache management. However, they may not be enough, in all cases to satisfy the users in regards to response time for HTTP requests. One of the interesting trends that merits examination is the power of Internet Agents that could enrich the WWW caching service. For example, the idea of "smart browsing", where according to the trace of previous user's requests, some probable variants for future requests are predicted and pre-fetched. This could significantly improve service, as users would probably not pay anymore than the price of the first click. With the current technology for WWW caching, the user always goes to the Internet if his/her URL has never been requested before.

6. Conclusions

According to our results, cache users do not influence each other's response time for HTTP requests unless there are more than 100 (approximately) people who use proxy cache in the same time. For small and medium size enterprises (approximately up to 120 web users) it is rational to build a caching service on only one stand-alone server, which could also be a level of hierarchical tree of caching proxies. For locations where more users access the WWW at the same time, e.g. corporate caches or ISP caches, we recommend using cache arrays running with CARP, configured from several caching proxies. When a cache array is used, the more servers form an array, the better the scalability it has. CARP caching in general is preferable to ICP.

Considering the possibility of keeping the MS Proxy Server logs in the MS SQL Server database, when WWW caching is the primary reason of the server, we recommend having the database server running on a different computer.

Site replication can be an alternative to WWW caching in the case where the site is not updated frequently and most pages of the site have a total size of all objects greater than 200 KBytes. Even then caching is still preferable, because statistically cached data were found to be 98% reliable in any scenario.

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Web Technologies as Means of Post-Secondary Improvement in Physics Education

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Abstract: the chair of the General Physics achieved positive results directed to improvement of post-secondary physics education. For the present day the "Mechanics" section has been developed. We have concluded the theoretical part, have prepared questions for self-control, home assignments and detailed step-by-step instructions for solving problems, tests. The teacher is available by E-mail. The students can be consulted by the chat channels.

The development of post-secondary education has been faced very serious problems recently. It is caused both by the level of teaching getting worse and by canceling the obligatory graduation exam on Physics. Partially this problem may be solved by preparatory courses. But this works only for the students who have an access to full-time education. But this problem still remains for many first-year students who didn't take the entrance examination. At first, it's a challenge for the students to adapt to the growing volume of information and for the teachers to change the politics of education depending on the level of the students' knowledge.

Development of new information technologies (NIT) and specifically Web technologies has led to the possibility of their wide application in educational process. General physics department of Petrozavodsk State University realizes conception of NIT introduction into the teaching process and does a lot of work directed to the realization of distance learning of students with the help of computers.

Our idea of distance learning is to afford students an opportunity of getting their knowledge in different sections of Physics without direct presence of a teacher, but under his active participation. Using INTERNET resources a student can get necessary information and communicate with a teacher staying at home or at the computer centres.

Introduction of distance learning allows to solve the following problems:

- to make it easier for students to acquire the theoretical material;
- to stimulate their independent work;
- to simplify teachers control over the current progress of students;
- to ensure distance learning of applicants for university admission;
- to promote mutual work with colleagues from other university centers for introducing new methods of teaching physics.

We would like to single out the following directions in NIT introduction and organizing the process of distance learning: improvement of the theoretical knowledge systematization, modernization of the methods of conducting practical classes in solving problems, automation of the conducting and checking up tests and independent work. Let us consider the perspective in details.

1. Using NIT for systematization and helping to acquire theoretical material allows us:

- to organize remote delivering of lectures along the allocated telecommunication channels;
- to make demonstration experiments by means of a computer and projection system and to present the material of a lecture visually;
- to provide strict sequence of material exposition and accessibility of its changing by means of presenting it in electronic form;
- to help students to study the theory material independently by placing it on PSU Web server.

2. Introduction of NIT into carrying out practical classes of solving problems allows us:

- to carry out practical classes based on specially worked out computer programmes united into the network with the use of standard software provision and computer technology possibilities;
- to ensure the process of individual teaching of students depending on the assimilation degree of the material with the help of worked out interactive programs;
- to organize remote conducting of practical classes.

3. Introduction of NIT will allow us to organize periodic automatic control over the assimilation of material, namely:

- to check the progress in studies by tests formed at random from the problems of different complexity;
- to analyze the results of the tests automatically by server;
- to organize the process of automatic self-certification of students with displaying the current grade;
- to carry out remote control tests.

The chair of the General Physics achieved positive results on these directions, received thanks to the distance learning teaching project, financed by Soros fund. The project is directed to making high school students` preparation better and it`s supposed to be put into practice in a region school of Republic Karelia. In our work we have used 40 year experience of the chair staff in students` preparation.

For the present day the "Mechanics" section has been developed. We have concluded the theoretical part, have prepared questions for self-control, home assignments and detailed step-by-step instructions for solving problems, tests in sections "Kinematics", "Dynamics", "The Law of Conservation", "Oscillations". The teacher is available by E-mail. The students can be consulted by the chat channels for example with the help of ICQ program or Netmeeting program.

Corresponding materials are presents in Web format and written in HTML-3.2 and Java Script languages. One can find an English variant of demonstration version in the URL address: www.karelia.ru/psu/KOF/abitur/demoeng/index_e.htm. At present the department of general physics together with the Regional Centre of NIT and the department of the foreign languages carries out multi-media technologies in the preparatory applicant course and its complete English version.

Distance Education Infrastructure for Rural Areas Using Java as a Development Tool

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Abstract

New information technology is fast becoming part of the localized education process, whilst offering the tools and the infrastructure for the establishment of a distance education process. At Rhodes University, we have built IRTS (Interactive Remote Tutorial System); a computer based system to support distance education. IRTS will be used as an instructional medium that would meet the needs of the learner in a manner that is instructionally effective and economically prudent. In this paper we describe the design and implementation of IRTS as an web-based distance education delivery system, which allows an instructor sited remotely, and connected via normal phone lines, to provide two-way voice communication within a class and remotely navigate web-based lesson material.

Key words: distance education, shared application, remote control, and web-based instruction.

1. Background

Within the context of rapid technological change and shifting market conditions, many educational institutions are challenged with providing increased educational opportunities. Most of these institutions are answering this challenge by enhancing their education process and adding new technologies within their distance education programs. At its most basic level, distance education takes place when distance and technology separate a teacher and students. These span the technologies of:

Voice: Instructional ***audio*** tools, which include interactive technologies of telephone and audio conferencing.

Video: Instructional video tools, which include still images such as slide presentations and video conferencing.

Data: Computers send and receive data electronically.

Print: This is the fundamental element of distance education information systems and the basis from which all other technologies have evolved.

The use of these technologies within distance education is driven by opportunities to:

- reach a wider student audience
- meet the needs of students who are unable to attend campus classes and
- involve outside speakers who would otherwise be unavailable

With the above technologies in mind, the Leather Industries Research Institute (LIRI) of Rhodes University, which has long been involved in distance education in the form of **Print**, decided to use the Internet as one of their delivery mediums. The main drawback with using the Internet was bandwidth, since most of their students are spread across the countries of Southern Africa and are connected to the Internet with low bandwidth, if at all. To address this shortcoming, we built a point-to-point Interactive Remote Tutorial System (IRTS), which allows remote navigation of HTML-based lessons. The Web-based lesson material is pre-loaded onto the local and remote computers. IRTS is a client-server Java application, which can be used from Java-enabled Internet browsers such as Netscape Navigator and Microsoft Internet Explorer. IRTS consists of: a MiniNavibar which is a graphical interface that allows local and remote navigation of HTML slides; a chat environment where participants can type and exchange textual conversations; and a shared whiteboard that allows teacher and student to sketch diagrams or drawings simultaneously.

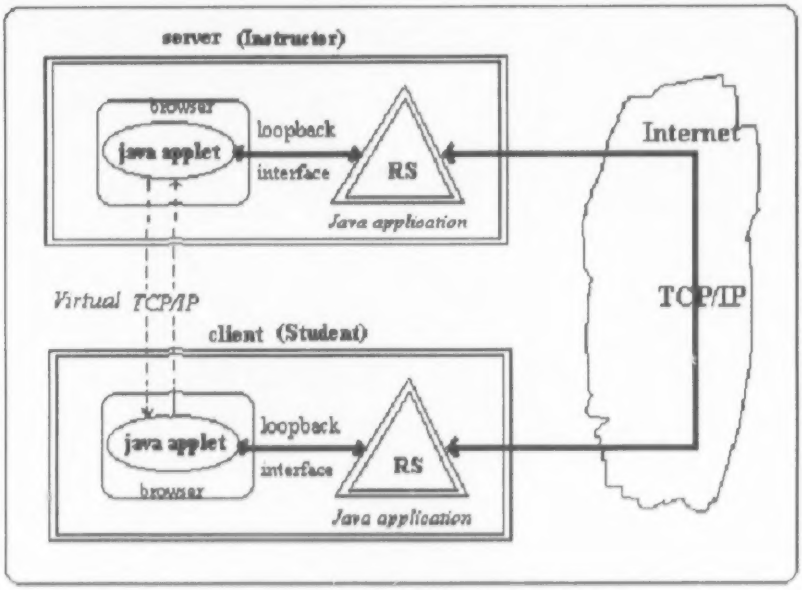

Figure 1. Overall System Architecture

2. IRTS Architecture

Figure 1 depicts the overall system architecture of IRTS, the relationship and communication paths among the two participating parties in a tutorial session. Our model takes advantage of the client – server architecture of the Internet [2], in which a client represents the student's corner and the server being the instructor's corner. As shown in Figure 1, IRTS consists of two components: a Java applet and a Relay Server (RS) for both client (Student) and server (Instructor).

The Relay Servers (RS), shown on Figure 1, are stand-alone Java applications, which have one distinctive function of forwarding all messages from the client applet (students) to the server applet (server) and vice versa. The dotted lines between the two applets represent a two-way TCP/IP communication between the instructor and the students, but due to the security restrictions imposed by Java (i.e. an applet cannot establish a network connection to any server other than its host machine), we had to implement two Relay Servers in order to establish a TCP/IP link between the client and the server. Another factor contributing to the design of the Relay Servers was the fact that the lesson material has to be pre-loaded locally onto the client and server applet's machines, before each tutorial session. Thus, during a tutorial session both applets will access the lesson material from the local disks. The applet acts as Tutorial Session Manager and it provides the user with a graphical interface with options to start or quit a tutorial session. It is composed of four components that run as separate threads of execution. These include a MiniNavibar, a whiteboard, a chat-box, and an Event Manager.

- **MiniNavibar**: This is for controlling local and remote simultaneous display of slides between the instructor and the students. Its navigation panel consist of a button bar with *Home*, *Next*, and *Previous* buttons. When IRTS is started, both the client and the server applets instantiate a copy of MiniNavibar and is displayed throughout the tutorial session.
- **The Whiteboard**: This is simply a "computer" whiteboard with tools for sketching diagrams or drawings. The whiteboard can only be started and destroyed by the instructor and it is opened as a separate window, which can be minimised and maximised. When the instructor opens the whiteboard, a copy of it is automatically opened on the student's computer.
- **The chat-box**: It is implemented as a client – server process, where the client thread runs on the student's machine while the server process runs on the instructor's machine. It also is automatically instantiated when an ITRS session is established and it runs as a low priority thread
- **Event Manager**: This forms the core of the collaboration mechanism between the instructor and the students. It is started automatically every time a tutorial session is established. The Event Manager

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consists of two processes: an event *Sender* and a *Consumer* .The *Sender* is responsible for sending the mouse events and other IRTS related messages among the participating parties. The *Consumer* is responsible for receiving these events and other messages from the sending application.

3. The Collaboration Client-Server Design

In our system both the client applet and the server applet share the same MiniNavibar and whiteboard graphical interfaces. We implemented a technique to intercept all user's MiniNavibar and whiteboard events, and send them to the other participant during a tutorial session. This technique is discussed in section 5.1 and 5.2. All the GUI components defined in the MiniNavibar and the whiteboard from both applets implement this technique. When starting a tutorial session, the first task of IRTS is to establish a network connection between the two applets. Since the applets reside locally on the remote machines and are not allowed to directly make network connections, each applet (i.e. instructor's applet or student's applet) establishes a connection with its RS using the loop-back interface. This loop-back interface prevents unnecessary traffic and limit bandwidth utilisation on the LAN.

Once these inter-connections have been established by both participating parties, the two Relay Servers, i.e. the client RS and the server RS, establish a TCP/IP link with each other. The solid line in Figure 1 represents this link. When the clientRS-to-serverRS connection has been established, events and any other messages can be sent and received between the two applets. During a tutorial session both the instructor and the students can remotely control the display of the slides using MiniNavibar. But, the instructor has higher authority over the slide presentation, hence the instructor can disable

When a user interacts with a GUI component of either the MiniNavibar or the whiteboard in IRTS, the Java component Event-handlers, *handleEvent()* and *action()*, are called. We then override these two methods such that a *Sender* method, which sends the event generated to the corresponding participant, is called every time the two event-handlers are called. The structure of the event is flattened to a string representation before it can be sent across the network, to be received in the corresponding applet by a thread in a busy-waiting loop, receiving events and other IRTS related messages. The received event is then reconstructed from the string representation and the target component is located and is finally posted by the receiving applet. When the event is posted in the receiving applet, the Java event-handlers are called as if it was a normal local user-generated event. The MiniNavibar and the whiteboard events that come from the network are tagged, such that they cannot be re-sent to the sending applet. This technique prevents an infinite loop of sending the same event the student's MiniNavibar and thus gaining total control over slide presentation.

4. The Relay Servers

The major function of the Relay Servers implemented in IRTS is to act as distributors of IRTS messages among the two session participants i.e. student applet and the instructor applet. The IRTS Relay Servers make use of two communication channels:

1) Client/Server Applet–to-RS channel
   This channel is responsible for transporting messages between the client/server applets and the Relay Servers. It uses the loop-back interface.

2) Client RS –to- Server RS channel
   This channel uses TCP/IP for communication between the client RS and the server RS.

Each RS has two threads that loop continuously: one for forwarding messages between the client/server applet and the RS, and another one for forwarding messages between the two Relay Servers. The packet format to exchange information implemented by IRTS is:

length	*packet type*	*data*

The packet type field represents the following event classes:

START	Start a new tutorial session
QUIT	End the current session
CYBER	A miniNavibar message
CHAT	A chat-box message
DRAW	A whiteboard message

5. Event Handling

between the instructor and the student machines.

5.1 Flattening and Sending Events

Before an event is sent by the *Sender* process of the Event Manager, it has to be converted to a representation suitable for transportation over the network. This representation has to contain sufficient information for the event to be easily reconstructed and posted to the correct target component by the *Consumer* process of the receiving application. The attributes of a Java event object are shown on Table 1. With bandwidth restrictions in mind we minimised the information on our event representation as

Attribute	Description
id	Type of the event
x	x coordinate of the event
y	y coordinate of the event
key	Key pressed in a keyboard event
clickCount	Number of mouse clicks
modifiers	State of the modifier keys
when	Time stamp
evt	Next event
arg	An argument of the target component
target	The target component of the event

Table 1. The attributes of a Java event

much as possible without sacrificing too much information. We did not incorporate the *clickCount, when,* and the *evt* fields in the representation. In our string representation of the Java component event, the remaining fields get their designated positions separated by a colon (:). Each event is flattened by concatenating the string representation of each field and sending the resulting string in the *data* field of IRTS packet format. The resulting string representation is shown below.

id:x:y:key:modifiers:arg

5.2 Reconstructing and Consuming Events

When the Event Manager's *Consumer* process of the receiving application receives a message that originated from the chat-box, it extracts the data from the *data* field of the packet. It then forwards this data to the chat-box process of the receiving application, which then displays the data on the chat-box's Text Canvas. On the other hand, if the message originated from either MiniNavibar or the whiteboard, the *Consumer* extracts the event and forwards it to either MiniNavibar or the whiteboard. The event is then reconstructed and posted to the target component of the receiving application. For the event to be posted, the matching target component must be located. In Java, a GUI component has no explicit identity. In our case, we use the *arg* field of the generated event to locate the target component. This is possible because both the client and the server applets (for students and the instructor) execute the same copies of MiniNavibar and the whiteboard. For example, when the instructor presses the MiniNavubar's *Next* button on the server applet, an action event is generated. This event is then intercepted and sent to the student's computer (client applet) by the *Sender* process. This event is then received by the *Consumer* process of the client applet and the *arg* field, which is the label of the *Next* button, is used to uniquely identify the target component, which in this case will be the MiniNavibar's *Next* button of the client applet.

5. Lesson Management

When IRTS is loaded onto a computer, two named frames are created. The client/server applet is loaded into one frame and the second frame is used for displaying the lesson material. The lesson material has to be developed into a sequence of HTML slides. Since the lesson material resides on the local disks of the participating parties, the client/server applet loads the slides into an array during start-up. MiniNavibar is used for the presentation of the slides. It keeps track of the current page, and its navigation buttons simply navigate the internal tree in an obvious sequence and the relevant URL (slide) is loaded into the second frame. For example, when either an instructor or a student presses the *Next* button, the array index is incremented and causes the appropriate slide to be displayed on the second frame.

6. Hardware and Software Requirements

The hardware required for IRTS at each site is:

1.
   a) Any Java 1.0 compatible computer

2. A monitor capable of SVGA graphics, 800x600 resolution; suggested sizes are:
   a) 14 – 15" inch monitor for 2 participants
   b) 14– 17" inch monitor for 2 – 4 participants
   c) 17 – 21" inch monitor for 4 – 5 participants
   d) more than 5 participants require an extra monitor or a projection system

The IRTS software requirements include any Java capable Internet browser and Sun Microsystems JDK 1.0 SDK. The type of audio equipment needed varies depending upon the number of participants during a tutorial session, the size of the classroom venue, acoustics, and other factors. However, each site must have a full-duplex speakerphone, and a direct analogue phone line.

7. Conclusions and Future Work

The Interactive Remote Tutorial System (IRTS) presented in this paper provides a point – to-point link between two applications running on any Java-capable Internet browsers, and it allows remote navigation of HTML slides by an instructor or students sited different geographical locations. It is able to be used on very low bandwidth connections, as only the event information is parsed between the instructor and student machines. IRTS also provides extra features, which include a computer whiteboard and a chat environment. The system is currently useful for delivering distance education to remote regions, using two dial-up telephone lines (one for computer communication and the other for interactive voice communication), or a basic Internet connection and a telephone call.

Our next goal is to extend IRTS into a point–to-multipoint system. Other issues to be addressed in our future work are scalability through use of reliable multicast protocols; the integration of audio and video; and use of centralised server for keeping the lesson material.

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SKILL – A Scalable Internet-Based Teaching and Learning System

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Abstract: This paper describes the architecture of a scalable Internet-based teaching and learning system (SKILL) currently developed at the University of Essen, Germany. The system will be developed first with the focus to the department Information Systems and Software Technologies, but is designed as a scalable architecture for a much wider scope. The primary objective of SKILL is to provide students a collaborative and adaptive learning environment utilising new web technologies proposed by W3C. Basic components of SKILL are (a) course material based on concepts which are organised in an ordinal rating derived from pre-requirements (b) annotation facility suited for collaboration work and (c) configuration environment for tailoring the system.

1 Introduction

The curricula of many or maybe most German universities are currently under discussion. On the one hand public universities have to face a growing competition from private universities, on the other hand there is a strong desire from government and industries to shorten the length of the studies and to allow higher flexibility and more specialisations. As a consequence classes become more heterogeneous. Traditional ways of teaching are not longer sufficient to cover the continuous' growing requirements on students. In our project we are developing a scalable Internet-based teaching and learning system. The main goal of the system is to cope with the different knowledge level of the students and with their different learning preferences. The new learning environment should be more flexible in presenting contents by adapting individual needs and should allow collaborative work by supporting learning groups. In our architecture the students can extend the system in various ways, these extensions are the source for improved revisions of the courses.

The system is currently in the design phase. In this paper we will discuss our design of the architecture and we will address various implementation considerations.

2 SKILL Functionality

Basis for the SKILL system is the actual learning material developed at the department which is currently available on the Web in form of course slides converted to HTML, additional references, and handouts. Starting from this basic pool of concepts a knowledge pool is generated. The knowledge pool contains the material of all courses offered by the department. The courses elements are course units and concepts. A course is composed of course units. Every unit contains concepts, which require some prior knowledge (concepts as well). Every concept is represented by one or more documents and additional navigation information. A document is either a content-document or an exercise-document.

When a course is designed, a set of relevant concepts is selected by a teacher from the knowledge pool (Fig. 1). The selected concepts are grouped into course units and a navigation path through

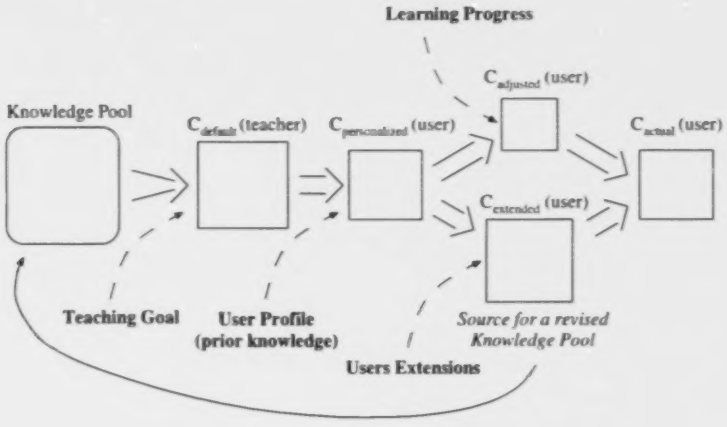

Figure 1: Course Refinement Levels

these concepts is defined. Every concept can be part of multiple courses. The navigation path forms a frame for the course and will be held physically separated from course contents. This separation between course contents and the navigation path can be kept on the logical level or can be resolved by integrating the navigation path into a visited document.

A course C generated in this way will be called in the sequel "default course" and represents the required knowledge taught by the course as defined by the teacher.

$$C_{default}(teacher) = Knowledge\ Pool + teaching\ goal(teacher) \quad (1)$$

Beside the walk through the default navigation path students can drill down into each concept. Hence for every concept related materials are available as cross references to the actual concept. When a student follows a cross reference he/she leaves the default navigation path, but can resume at this point at some later time.

The users of the SKILL system can be divided into different groups. The individuals working with the system are classified either as "students", "teachers" or "administrators". The union of these classes builds the group "users". Students who are enrolled in the same course can create a new group for collaborative work. This group will be a subgroup of students.

2.1 Adaptivity and Progress Control

Traditional teaching approaches do not consider the heterogenous knowledge level of the students in a class[1]. The SKILL system is designed to allow to customise the students' learning environment according to their personal knowledge and their special interests. In particular a student can choose the course to enrol and specifies a start configuration in the following way: For every course there is a default configuration prepared by the teacher. If a student has already knowledge of some of these concepts obtained by the system, these concepts are marked in the users profile and can be automatically removed. If the student has this information from other sources he can mark the concerned concepts as known and is prompted by the control questions from the tutoring component. When these exercises are successfully solved the known concepts are removed (hidden) from the course. If the student does not want to answer the control questions, the concepts to be removed are marked specially until the

[1] From our experience this problem is especially apparent in the area of information systems.

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student solves the exercises at later time. Through these customisations a course is personalised by the user.

$$C_{personalised}(user) = C_{default}(teacher) + profile(user) \quad (2)$$

The personalised course is the basis for the students' work during the course. By the continuous learning progress of the student more and more concepts of the course are reached. For all of these concepts, control questions are asked, and more and more concepts are marked as known in the users' profile. This information is kept as well in the system logs and influences the dynamically generated course. By taking the learning progress of a student into account we obtain the adjusted course:

$$C_{adjusted}(user) = C_{personalized}(user) + progress(user) \quad (3)$$

2.2 Collaborativity

In addition to the adaptivity described in the previous section, every student (or learning group) can extend the default information space by *annotations* and additional concepts or single documents (*course extensions*) and share this added information. The system allows extensions for the following purposes:

1. Private annotations
2. Private course extensions
3. Shared annotations and shared course extensions

A student can generate personalised documents by adding private annotations to every available document. A student can add as well new documents (or concepts) to the course in order to associate the collected material with own contents or to develop a proposal for an extended version of the course. A teacher can make the same private extensions on his or her side. All course extensions are added to the navigation structure.

Annotations Every annotation extends a source document – or more precisely – an HTML/XML element of the document (D_e). Two facts distinguish the SKILL annotations architecture from other systems like, e.g., Hyper-G [Maurer 96]: (1) An annotation is not only associated with the whole document but with a certain part in the document and (2) annotations are related to user groups or individual users and are controlled through an access-control system. By this means a student can add private, public, or only for certain groups accessible annotations which are treated by the system as different annotation sets. Any personalised document is synthesised from the source document and in-line positioned annotations. Valid to a special user are all annotations made by himself as well as all group-related annotations made by members of groups the user belongs to. To differentiate between the source documents content and annotations the latter will be indicated by a special text colour or format which can be specified through CSS. The personalised document can be described as follows:

$$\begin{aligned} D_{personalized}(user) = {} & D_{source} \\ & + \bigcup_{i=1}^{n} Annotation_i(D_e, user) \\ & + \bigcup_{j=1}^{m} \bigcup_{i=1}^{n} Annotation_i(D_e, group(user)_j) \end{aligned} \quad (4)$$

Course extensions The user (student or teacher) can extend the courses scope as well. As mentioned above a course is built from concepts consisting of a set of documents and a navigation path through these concepts which is held separately. The separation between navigation path and learning contents allows students to extend the course contents without changing source documents. Students or teachers

can integrate new documents related to a courses' element C_e content in the navigation path at any position. An extension can be a complete new concept consisting of a set of documents in a course unit or a single document as part of a concept. An extension may contain arbitrary objects such as software packages, seminar papers, etc. All extensions of the course material are subject to access control as well. By adding annotations and further documents learning groups can create their own workspace for collective use.

The addition of new documents can be performed by both students and teachers. Consequently it must be differentiated between authorised additons from teachers with a binding character and addions from students with informational character. This difference can be expressed by membership in different groups which will affect the appearance of an extension in a courses' navigation path.

$$\begin{aligned} C_{extended}(user) &= C_{personalised}(user) \\ &+ \bigcup_{i=1}^{n} Extension_i(C_e, user) \\ &+ \bigcup_{j=1}^{m} \bigcup_{i=1}^{n} Extension_i(C_e, group(user)_j) \end{aligned} \tag{5}$$

By adding the adjusted course (see formula 3) into this formula we obtain the course as a personalised, adjusted, and extended working course material as perceived by a user of the system:

$$C_{actual}(user) = C_{extended}(user) + C_{adjusted}(user) \tag{6}$$

3 Components

This section sketches the components of the SKILL system needed to provide the described functionality.

Security Components For realizing the adjusted course contents and the personalised and shared course extensions a personal user identity is essential. For the rights managements of individuals and groups we are planing to use a role based access control system (RBAC) [Sandhu et al. 96] which can be applied to web documents in a straightforward manner [Neumann, Nusser 97, Nusser 98]. The RBAC systems allows us to assign access rights to roles instead of users. This provides a convenient mechanism to manage the rights by separating the question of "which role needs access to which objects" and "which subject is in which role". By assigning a user to a role he/she is authorised to access all necessary objects. The basic roles are (1) the role of the students which allows them to use the course material and to extend the system with contents having an informational character (2) the role of the teachers which enables creating default courses and extensions and (3) the role of the system administrators. System users exist as individuals and group members. The user authentification will be realized by digital certificates [CCITT 89] via SSL. The fact of authentification is important in allowing users to extend the system by annotations to documents or including new documents.

Document Management The comprehensive course materials are only manageable by a effective document management system. We decided to use XML [W3C 98b] and CSS [W3C 98a] as document structuring and layout definition languages since these standards proposed by the W3C are highly scalable, very flexible, and designed for the use on the Web. Furthermore version management will used as well as mechanisms to check link consistency. The current, HTML-based system uses CVS [Berliner 90] for version management.

Tutoring Component The tutoring component provides a users' personal environment. It supports a personal configuration by storing a user profile. Furthermore it is responsible for logging the students' learning progress by storing visited concepts and exercise results. The tutoring component offers exercises in order to monitor and exercise the students learning progress.

4 Implementation

As mentioned above the SKILL project is an ongoing project which is not yet implemented. This section discusses various implementation issues that are entailed by the requirements.

All data belonging to the knowledge pool and all default navigation paths are stored in a area which is accessible for all registered users. Additionally every user and and every group has a home directory assigned which stores the private or group related extensions and annotations under a name with a reference to the source they are related to. The actual course navigation path is generated by a CGI-script which composes the path considering the default course, private and user group related extensions, and the learning progress. Handling the students learning progress can be done by using the browser-implemented concept of visited links in addition to the exercise results.

The implementation of the synthesis of the personalised documents from source documents can be realized by CGI-applications in the following way: For every request for a document a script is called which composes the personalised document from source document for all annotation sets in the relevant directories.

In order to store the position of an annotation in a document we will follow the approach proposed in [Röscheisen et al. 95], where the position of an annotation is stored together with the annotation itself. That means that the annotated document has no information about being annotated. The annotation needs the information about which document it is related to and at what position in the related document. This will be realized by a method named string position trees [Röscheisen et al. 95]. Each annotation is associated to the text part it is related to and to a position identifier string. Position identifier strings are defined as the smallest internal identifying string sufficient to locate a text position without ambiguousness.

In case the modification of the document breaks the position identification property, context information is kept as well. The context information is the textual context before and after the text position. The context information allows the repositioning of annotations in case the position identifier string mechanism fails in locating the annotations' position.

If both the smallest identifying string and the text context fail to locate the correct position, the annotation will be placed at the end of the document and marked as unassigned. Deviating from [Röscheisen et al. 95] the document merging procedure in the SKILL system is not implemented as a extend browser-feature but rather by an independent CGI-script usable by every standard browser.

The described functionality (adaptivity, annotations facility, etc.) could be implemented as a Java-applet or by CGI-scripts. In result of this trade-off we decided for the latter one. Realizing all necessary functions which provide adaptivity and annotation possibility in an Java-applet is maybe more comfortable to use, but means to disclaim the flexibility which is given by using CGI-scripts. An development basing on CGI-scripts which edit the files preserves the possibility to change the textual elements inside of an HTML/XML-file.

5 Conclusion and Related Work

The purpose of this paper is to describe the architecture of a teaching and learning system which allows user extensions, annotations to documents and a personalised configuration. Several of these functions are adressed by other software developments as well which have in parts similar purposes. The aim of a number of software developments (e.g. group-ware systems) is to provide a shared workspace that allows collaborative work. Using the WWW as a communication infrastructure is recommended because (1) the WWW gained a broad acceptance, (2) WWW is easy to use and (3) the needed client software (browsers) and extensible server software exists for all important platforms.

One of the first applications using the web infrastructure to support collaboration work was the BSCW-system [Appelt, Busbach 96] developed at GMD in 1995. BSCW is based on the terminology of a shared workspace which is used as an information repository for various type of objects like documents, pictures, spreadsheets etc. BSCW users (in accordance with their access rights) upload, modify

or remove objects from workspace, so it covers parts of the SKILL functions. The source code of the BSCW-server is freely available, can be integrated into SKILL and extended for further functions.

CoopWWW [Appelt 98] is a project funded by the Telematics Application Programme which puts up on BSCW system. The goal of CoopWWW is to offer a set of tools supporting group cooperation using the BSCW system as kernel of this toolkit.

A further development in the area for collaboration work is OzWeb [Kaiser et al. 98]. OzWeb is developed with the focus to support workflow enactment for distributed groups in a collaboration environment. OzWeb offers a tool service which is available on multiple platforms and allows common processing of a workflow.

The functionality offered by SKILL will combine collaboration aspects with individual adaptions. The focus lies on supporting learning and teaching processes. The initial SKILL development will be performed using the Cineast web browser [Köppen, Neumann 97] which is also a development at our department. Nevertheless we hope that most functionality will be available on all standard web browsers, once they have better XML and CSS support.

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An Investigation into the Effect of Hypertext Structure on Student Use of Courseware

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Abstract: *Courseware for a particular University subject has been available on the Web for a number of years using a very simple hypertext format. Server logs have previously been analysed to determine the amount of student usage. This paper reports on a restructuring of the courseware designed to produce increased use by means of a more sophisticated hypertext structure. The time costs in this restructuring as well as the failure to increase usage are reported. This has particular implications for educational institutions attempting to persuade instructors to place courseware on the Web.*

1. Introduction

Generating course materials in a suitable form for students is a principal function of a instructor's job. The time spent in preparing this courseware, and the corresponding cost in the salary of the instructor and any support staff can vary greatly depending on the presentation forms chosen. This time - and increasingly for computer-based systems, also maintenance time - has to be factored in when preparing courseware.

Web courseware has traditionally (i.e. over the past few years) been viewed as ``free" due to the enthusiasm of early adopters prepared to develop materials in their own time, and due to the lack of charges made to view the courseware. This is now changing: partly because an increasing number of Universities are restricting access to courseware, limiting it to their own revenue-raising students. In addition, University pressure for flexible delivery mechanisms is forcing more academics to place courseware on the Web even though they may feel it is an additional burden on their time.

The subject Operating Systems at the University of Canberra has been available in Web format since 1994 [Newmarch 1996]. This was done with very few additional overheads by converting from an existing electronic form, by placing each section of the course on the Web as a single document and adding very little hypertext structure. This simplified maintenance (as well as other things such as making printing simple!).

From a low use in 1994 because the Web was young, the courseware had quite high usage in 1995. In 1996 this fell off, possibly because students realised that the Web form used was very similar to the printed form and lacked many useful features of paper-based versions, such as being able to be taken to a lecture and annotated.

In 1997, a major restructuring of the courseware was undertaken. The main purpose of this was to add features that were not possible in a paper-based version, such as multiple guided paths through the courseware. The intent was to see if this would lead to increased use by students and increased satisfaction, but also to assess the extra time cost of preparation in a more complex form. The restructuring was performed by a single (knowledgeable) instructor - this is looking at the kind of work that may be performed by an individual or a small team rather than by a major University effort.

This paper tests the hypothesis that the navigational structure of Web courseware affects the amount of use students will make of the courseware. It also estimates the extra time cost that is involved in adding navigational aids to courseware.

2. Simple Structure

Courses at the University of Canberra in Information Technology areas are usually lecture-based. Students expect to receive instruction in one hour-sized chunks. Each lecture generally consists of a single major topic. Some topics may be carried on beyond this scale, but each lecture forms a relatively self-contained whole. For example, for the subject Operating Systems, lectures were: File Systems, Directories, Memory Management, Virtual Memory, etc. The simplest organisation is to prepare each lecture as a single HTML document.

A central navigation page can list all of these lecture pages and any others of interest such as assignments and tutorial exercises. Links between lecture pages can be kept to a minimum. This gives a tree structure with one level in Figure 1.

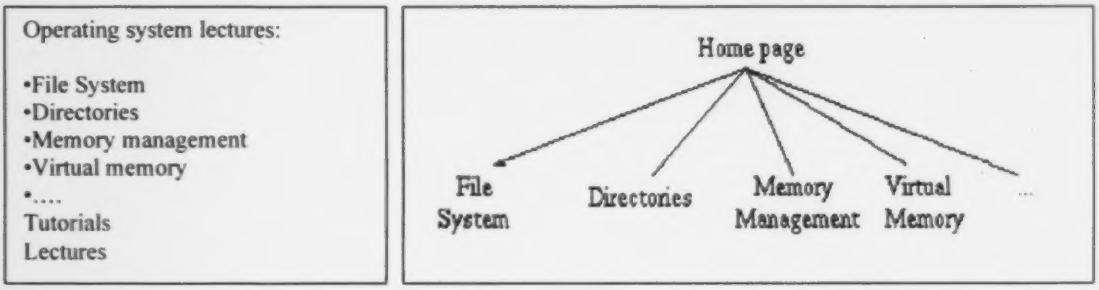

Figure 1: Simple course stucture

This provides about the minimal structure needed to make the material available on the Web. It has the advantages of being easy to maintain the hypertext structure (since there isn't much) and being easy to print. Keeping the content up to date is an easy editorial task as there are not many files to edit. Essentially, this type of Web structure is just a table of contents of a set of lectures.

The Operating System lecture notes were kept in this form from 1994 to 1996. Access patterns to this were reported in [Newmarch 1997]. In brief: usage was low in 1994 because the Web was young, was high in 1995, and fell for local students in 1996. I suspect this fall was caused by two main factors: the novelty value wore off, and the students realised that there were only a few advantages over a paper-based version. Another factor may have been speed: Netscape grew in size, and we switched from SunOS to Linux in our own computer laboratories with a less efficient version of NFS. Startup times for Netscape were in the minutes rather than seconds, leading to less students bothering with it when a paper version was handy. Students had the advantage of paper-based versions being easily available through the local bookshop, and were able to make judgements on use based on the availability of these alternative media.

3. Fine Structure

A lecture on a topic such as File Systems will have many internal components: the general services provided to applications by a file system; the Unix API for such service; the DOS API for the same set; implementation techniques such as inodes, and so on. Generally these are broken into further subtopics, until the level of individual ``slides'' or other indivisible components is reached. For example, the ``table of contents'' may be expanded out as in Figure 2.

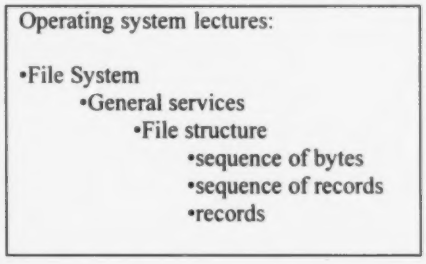

Figure 2: Fine course structure

Most linear courseware lends itself to a hierarchical structure that can be captured as a tree of hypertext links. Hypertext however encourages making alternative routes through courseware so that a student can choose the path they want to follow. These need not follow the hierarchical structure, but may cut across it. Such alternative routes must follow a structure of their own that is a valid structure for the couresware.

4. Intermediate Structure

The Operating Systems subject has a lecture-level structure, each lecture has a set of subtopics, and so on until we reach components that are indivisible. To produce alternative routes means linking the components in different ways.

Each lecture should have an overview, no matter what the courseware is about. This can be used as one alternative route, to give a set of overviews of the various topics discussed in the course Typically, each topic may also contain a summary, and these could be linked.

Further routes depend on the particular courseware, and how coherent it remains in moving from one topic to another. Some may have little coherence, some may have a lot. For this particular courseware it was possible to identify groupings of components, fairly similar to the subtopics of each lecture. Within each lecture there was usually some general theory, illustrations using the Unix Operating System and other illustrations using MSDOS or Windows 95.

These led to alternative routes through the courseware, as Overview, Generic, Unix and Win32. Some of the original material needed to be regrouped, but by and large it was fairly easy to place indivisible components into one of these four groups. In some cases a group really contains two or more subtopics, but these could be broken into separate parts without affecting the overall structure. Applying this to the courseware gave views such as the Lecture view, the Unix view and the Generic view in Figure 3.

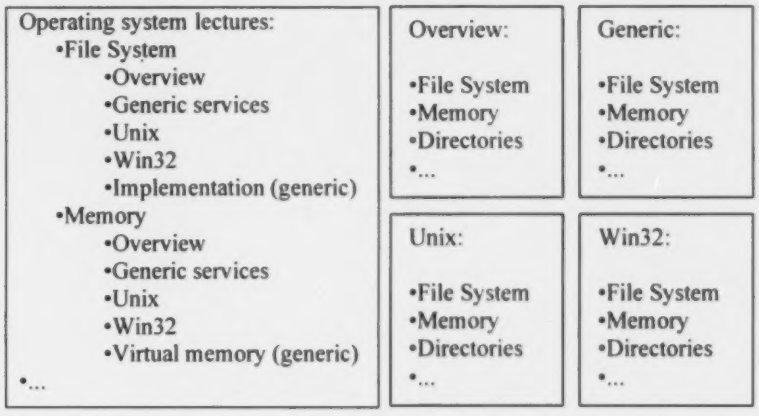

Figure 3: Flexible course structure

This structure was custom-designed for this subject. Other subjects may have greater or lesser success in finding such an intermediate structure, and the alternative navigation paths that this provides.

5. Time Costs

5.1 Simple structure

The simple structure is extremely low-cost. The original material for this was already in word-processor format, in fact as Interleaf documents. In 1994 there were no automatic converters to HTML. After a few experiments, it was decided to save the documents in plain ASCII text and add HTML markup by hand. This markup task was performed by a secretary in about a week for a complete semester subject. As an aside, two years later she expressed a desire to learn HTML, and couldn't even remember having marked up an entire subject earlier!

If the courseware is already in word-processor format, most likely there are now converters to HTML. This can reduce this initial markup even further. If the courseware has to be produced from scratch, the use of HTML-editors makes it as easy/hard as any other document formatting system such as WordPerfect.

Maintenance is also low-cost. The major task is text editing, with a few links to graphics files. If the courseware is relatively stable, this may take very little time.

5.2 Intermediate Structure

5.2.1 Granularity

Deciding the logical structure is a non-trivial operation. There will be a coarse breakdown in topics, and this was used in the simple structure. To produce a more fine-grained structure is far more complex: while it is easy to break any topic into smaller components, to break it into a set that is consistent with the breakup of all other topics is harder. An instructor will probably be aware of many possibilities for this finer structure, but it is necessary to decide between them and check that it will work adequately for all topics. Producing a coherent set of views for a course should have educational advantages.

Producing this structure is a significant effort, because it will affect both the work needed to create the courseware and the student perception of it. For Operating Systems, this task alone took nearly a week, and may not be possible for some courseware.

5.2.2 Links

The ability to allow multiple paths through a document set is a desirable feature of hypertext systems. This is intimately tied up with the finer structure of the courseware, as alternative navigation views will be alternative routes through this finer structure.

Ideally, the links need to be external to the documents. This allows a document to concern itself with content only, while the relation to other documents is handled elsewhere. However, this is not supported by HTML 3.2, as hyper links are encoded directly into documents. It is directly supported by hypertext systems such as Hyper-G (renamed HyperWave) [Maurer 1996], where the problems of embedded hyperlinks are described.

Many browsers support Frames, and this will become part of the HTML 4.0 standard. Frames provide a partial solution to this by allowing selection in one frame to cause navigation in another. Frames allow some navigation links to be handled externally to the documents. Using frames gives a physically more complex structure to the Web pages. For Operating Systems, about half of the pages are just support pages for the frames. Setting this up in a consistent manner across all pages took a week. This involved building a suitable directory structure, creating template files and also writing some CGI scripts to ensure that switching from one view to another updated all of the frames appropriately. Maintenance is also costly: to add a new element to a topic invoves updating four other pages; to add a new topic involves setting up a new directory with template files and updating six other pages.

This adds significant overheads to content preparation. The logical structure needs to be mapped onto the physical file structure. All navigation files need to be updated when changes are made. While parts of this can be automated, the failure of the topics to fit precisely into a fixed structure works against this. Different subjects will have different structures, so a general automated solution seems far away. I take about an hour to integrate a new topic into the existing ones, but then I know exactly the logical and physical structures I am dealing with. Other instructors may require the support of technical staff.

The cost of ongoing maintainence has not yet been measured as this is the first time it has been given in this form. However, fixing up ``bugs" - such as wrong links and incorrect titles in HTML documents - has cost many hours.

One unexpected cost arose in looking at search engines: most of the commercial search engines will not index through HTML frames [DeUlloa 1997], so all of the content was rendered invisible to them by using the frame solution adopted here. A week's work was involved in producing a non-frame version that would allow search engines to index the content. The revised pages still had to work with the current browsers that do understand frames, of course! Testing this was messy - it involved finding a browser that did not understand frames, and a version of Lynx on one of our older systems was finally used for this.

5.2.3 Navigation

In addition to logical navigation through courseware, students also expressed the need for position information - the added complexity made some people feel "lost" in the courseware. Position information can be given by consistent naming for both document title and first level header in the document that follows the logical structure of the courseware. This may produce fairly cumbersome names such as ``Operating Systems - File Systems - Generic Operations". Ensuring this is just part of the quality control of the courseware: something that just takes a few minutes, but has to be built into the process of creating documents.

For this subject, a map of the subject contents was generated by a CGI script, which located the user in the content element and allowed navigation to other elements. This map ignored things such as assignments, and tutorials and showed a simplified map of "real" content only. Building the CGI script for this took another week, which would not have been necessary in the simple navigation model.

6. Measures

6.1 Source Data

Surveys have been kept on the subject in all years. They show what surveys of other subjects show: approval of Web-based delivery [good questionnaire]. What they do not show is the use students actually make of the material, and this requires more objective measures. This is not to dismiss surveys, but to note that positive survey results are difficult to interpret if they form the only measure of the courseware.

Web servers can be configured to keep logs of all accesses made from them. Server log statisics need to be interpreted with care: for example, they do not measure the number of requests made, but only the number of requests that make it to the server [Noonan 1998] [Linder 1998] [Goldberg 1998]. The rest may be delivered from proxy caches along the way. Logs contain information about requests for gif images along with requests for documents. Generally, these will need to be filtered out before meaningful conclusions can be drawn.

6.2 Accesses to Courseware

Access patterns to the original lecture notes were reported in detail in [Newmarch 1997]. Tables for the new version are given in [Newmarch 1998]. Comparing the ``best" previous year of 1995 to the restructured pages of 1997 gives the graph of Figure 4.

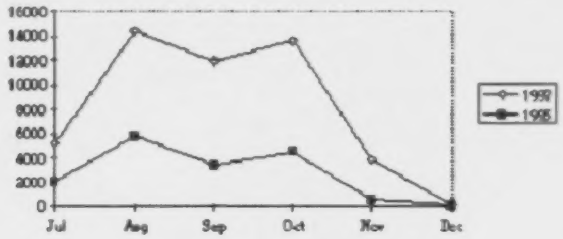

Figure 4: Monthly usage of old and new pages

The graphs deal with about 120 students in 1995 but only 90 in 1997. On the face of it, an improvement in usage has taken place. However, in 1997 the page structure was more complex, with about half of the pages being purely for navigation. In addition, each of the 1995 pages was split into four or more pages for 1997. Taking these into account reduces the difference so that there is no noticeable change in usage.

A "control" group of 30 students continued to use the old version, as they were taught the older version of the course. Making the same adjustments for structure, the control group used the old pages with the same frequency as the new students.

6.4 Cookies

Cookies are typically used by server administrators to track the set of pages retrieved during a "session", so that routes through the pages can be traced reliably. Cookies were added to the server for this site in order to determine if the alternative navigation routes were actually used. If they were, it justifies the structure adopted. If not, it weakens one of the reasons for this structure.

In [Newmarch 1997] it was reported that over half of the accesses to the Web courseware only looked at one page. This pattern has continued unchanged in the revised courseware. In one time period, there were 15,000 cookies recorded. However, 8,000 of these only looked at one page. Of those who explored further, the results of Figure 5 were recorded. These figures show that use was made of the new structure - although the "lecture" route was preferred, about a quarter of that number also explored the ``Unix" and ``Win32" routes.

route	lectures	Overview	generic	Unix	Win32
number	2815	314	423	730	698

Figure 5: Alternative routes through courseware

7. Time Costs

A simple structure is easy to setup and low-cost to maintain. Conversion from a previous document format only took a week when few tools were available.

For this subject, devising and implementing the more flexible structures cost about two weeks. Bringing in a new topic added about an hour of work, so two topics per week over a semester added about thirty hours of work in addition to preparation of the material in the first place. Maintenance time rose sharply using the more complex structure. The structure was not quite regular enough for an automated maintenance system. Minor errors had to be fixed on a regular basis. Tools to establish link consistency on the site had to be learnt and used. Modifications to allow search engines to access the courseware were unexpected. A site map had to be built to aid those who found the new structure too complex.

In summary, the amount of extra time spent on the courseware to build and maintain the more complex structure added up to about six weeks of work. Some of this involved highly technical work, writing CGI scripts. This is a significant overhead for a one semester course taught by a single instructor. If the courseware remains stable and reduces to maintenance only this should drop to a few days per semester, but of course this is unlikely given the rapid evolution of the Web.

8. Conclusion

Interest by students in Web pages that added little to printed versions of the courseware flagged after a few years. To regain this, a more sophisticated hypertext structure was put in place to allow students to navigate more flexibly around the courseware. This feature could not be done with traditional paper-based courseware. This added significantly to overheads on course preparation and maintenance, more than could normally be expected of a professor without significant assistance.

Student response was highly favourable to the new course structure. Cookie logs showed that students did make use of this additional flexibility. However, the logs showed that overall it did not result in an observable increase in the use of the courseware.

This paper varied the parameter of Web courseware structure in order to test the hypothesis that the structure will affect the amount of use students will make of the courseware. The results do not confirm this hypothesis. The time spent to produce courseware within these different structures was also estimated.

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Interest Discovery for Incremental Web Exploration

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Abstract: The growth of the World Wide Web has been identified as ``the phenomenon of the 1990's". The increasing numbers of Web sites and Web pages have increased the difficulty level for Web users to retrieve relevant information. This paper presents our approach to address this issue. We apply incremental knowledge discovery techniques to information retrieval on the Web. This paper provides an overview of current Web technologies, and describes our SiteHelper system in detail; its functionalities, design, architecture and its knowledge generation process.

1. Introduction

The expansion of the World Wide Web (WWW) [Berners-Lee 96] or the Web has been identified as ``the phenomenon of the 1990's" [Berners-Lee et al 94, Porterfield 94, Wiggins 95]. [Hobbes' Internet Timeline] and [Web Growth Summary] reported that the number of Web sites has increased from 130 in June 1993 to 230,000 in June 1996. According to [Netree Internet Statistics] there are more than 35 millions Web sites and 270 millions Internet users as at Saturday, 21st of March 1998 (Pacific time). Based on the data from [Internet Domain Survey], there are approximately 30 millions domains on the Internet and the domains are distributed as 8,201,511 for Commercial (.com), 5,283,568 for Networks (.net), 3,944,967 for Educational (.edu), 1,099,186 for US Military (.mil), 519,862 for Organizations (.org), 497,646 for Government (.gov) and others (e.g., 665,403 for Australia (.au)). The expansion of the Internet and the Web continues, and [Brown Computer Solutions] predict that there will be more then 100 million Internet hosts by the year 2000.

Search engines like [AltaVista], [Excite], [Lycos], [WebCrawler] and Web robots (or ``spiders", ``Web wanderers" or ``Web worms" [Koster 95a]) have been developed to assist users in finding information on the Web. Well-known Web robots include WebWatcher [Armstrong et al 95], Letizia [Lieberman 95], CIFI [Loke et al 96], BargainFinder [Krulwich 95], Syskill & Webert [Pazzani et al 96], and MOMspider [Fielding 94]. The Web page titled [Database of Web Robots Overview] lists 164 of these robots/agents as of 20th March 1998.

There are both advantages and disadvantages in using either search engines or Web robots to help search for information on the Web. With the continuing growth of the Internet, the search engines are under increasing pressure to be more "intelligent" in retrieving the desired information for users. However, they currently give the user a range of hundreds to tens of thousands of matching Web pages. For example, if you search for "Artificial Intelligence" using [AltaVista] you will receive half a million matching Web pages, while [Lycos] will give you about 1000 that spread over 100 result pages each containing 10. It is agony to go through each of the result Web pages to find the one that is of interest to you. When a search engine returns its results, it is more often the case that less than 10% of the matching Web pages are read or visited. [Etzioni & Weld 95] pointed out that for seach engines the number of false hits appears to grow rapidly with the size of the Web, therefore the search engines are unsatisfactory in the face of the Web's continuous exponential growth in content. Search engines are useful for finding Web sites but once an interesting site is found, the user would normally bookmark the site. Often users know about a Web site through friends, advertisements or other resources rather than just by surfing the Web.

Web robots are more intelligent compared to search engine with regard to resource discovery. However, robots require considerable bandwidth thus resulting in network overload, bandwidth shortages and increase maintenance costs. Robots generally operate by accessing external servers to retrieve information, which raises many ethical issues as to whether people should improve their system because too many robots are accessing their Web site. [Koster 95a] observed a robot visited his site using rapid fire requests and after 170 retrievals from the server, his server crashed. Considering many practical, fundamental and ethical issues surrounding the use of robots on the Web, a ``Guideline for Robot Writers" [Koster 95b] and ``A Standard for Robot Exclusion" [Koster 95c] were introduced.

According to [The American Internet User Survey] most Web users have visited under 100 sites in-depth and nearly 60% of Web users only visit less than 10 sites on a regular basis, which is considered to be at least once a month or more. Based on the above facts, considering the drawbacks of search engines and Web robots, we focus on assisting the Web user at local sites rather then the whole World Wide Web. To assist users in finding information on a localized Web site, the incremental knowledge discovery techniques are utilized. A software agent [Jennings & Wooldridge 96] named SiteHelper [Ngu & Wu 97] is designed to act as a housekeeper for the Web server.

The remainder of this paper describes the functionality of the SiteHelper system and its advantages; presents its design and architecture; discusses SiteHelper's incremental learning methods and the discovery of topics of interest; and draws conclusions about the issues raised in Sections 2,3,4 and 5 recpectively.

2. The SiteHelper

SiteHelper is an intelligent agent [Riecken 94] that learns a Web user's areas of interest and assists the user in finding information on a localized Web site. It functions differently from search engines and Web agents (such as WebWatcher [Joachims et al 95], Letizia [Lieberman 95], [World Wide Web Worm], Level 4 Web Tool [Cheung et al 97]) which help the user on the global scale. However, we can deploy SiteHelper on other Web sites to assist users in finding information in the same way. This design of SiteHelper has followed the ``Guidelines for Robot Writers" [Koster 95b] and hence avoids the drawbacks of existing robots. The following lists the advantages of having SiteHelper at a local Web site:

- With each Web site performing its own housekeeping comes the potential to develop a good methodology for information retrieval on the Web. By adopting this approach we shift the focus of assisting the user from finding relevant information on the entire World Wide Web to localized Web sites.
- SiteHelper reduces Web users' accessing and retrieval time.

We have two examples to demonstrate the second advantage above.

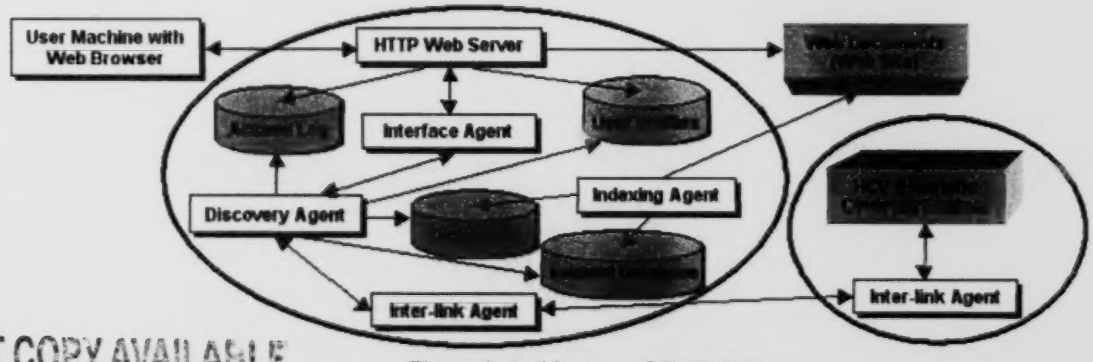
Example 1. Two months ago, a machine learning researcher visited the [BYU Neural Networks and Machine Learning Laboratory] Web site for a particular paper. On a relevant Web page, the postscript file of the paper was not available for downloading. When the researcher visits the same Web site again, SiteHelper displays a list of changes since the researcher's last visit. These changes are sorted based on the areas of relevant to the researcher's interest. By viewing these changes, the researcher knows whether the postscript file is now available or not, without having to access the Web page or searching the Web site again.

Example 2. A potential car buyer searchs for a particular car he/she would like to buy at a car auction site (e.g., the [Fowles Auction Group] Web site). On their first visit, there weren't any cars that suited the given criteria, but by using SiteHelper's resource discovery, it is found that the buyer likes a red Ford Falcon, automatic gear-box, ABS brake and a wagon etc. When the buyer visits the same car auction site at a later date, SiteHelper picks out a list of new cars that match the user's criteria or informs the buyer that no car suits the criteria again. Therefore by using SiteHelper, it saves the buyer from searching through the Web site to find his/her car.

It is important to note that the first time when a user comes to SiteHelper, it does not know anything about the user's interest. Its knowledge about the user increases as it continues to interact and receive feedback from the user, through both the interactive and silent learning methods that are discussed in Section 4.1 and Section 4.2

3. Design and Architecture

SiteHelper was designed and developed in a heterogeneous environment. Most of the components run on a Windows NT Server and the HCV [Wu 95] induction engine runs on a Unix Server, as shown in Figure 1.



BEST COPY AVAILABLE

Figure 1. Architecture of SiteHelper

Access Log. Most Web sites allow global user access to their Web pages, and have logging facilities in place [Pitkow & Bharat 94] to record users' access details. The access log of a Web site records all Web transaction/request services by the Web server. These records are in the European Microsoft Windows NT Academic Centre EMWAC format (National Center for Supercomputing NCSA format is an alternative). The three main elements for each record are: the machine name with its Internet address from which the access is performed, the date/time of access and the Web page being accessed.
Dictionary. The dictionary is a list of keywords that represent the Web site. This list is compiled by the Web site administrator. The dictionary is used to communicate with the HCV engine through the discovery agent.
Discovery Agent. The discovery agent manages major communications and tasks of the system. It reads the access log to collect records of Web pages that a Web user has accessed, and through the interface agent retrieves all the Web pages the user has not visited. In addition it matches the records with the user profile to compile a set of files and passes them to the inter-link agent.
Inter-link Agent. The inter-link agent forwards the files from the discovery agent to the HCV engine for rule generation. SiteHelper was developed across two different platforms, Windows NT and Digital Alpha Unix. To establish the communication between the two, the inter-link agent was built using Java.
HCV [Wu 93]. The HCV induction engine is the "brain" of SiteHelper. It takes two input sets of the Web pages: a set the user has seen, and the other the user hasn't visited. It generates rules in the form of conjunctions of keywords in the dictionary to identify the user's areas of interest.
HTTP Web Server. It transmits information using the Hypertext Transfer Protocol [HTTP], and serves requests from external browsers for Web documents on the Web site. This is the entry point for a user to use SiteHelper, with the user name and password to identify the user. Access details of the user are stored in the user profile. The HTTP Web Server is implemented using Microsoft Internet Information Server.
Indexed Database. This database stores all the Web pages that have been indexed by the indexing agent using the dictionary. The indexed database acts as a reference to both the discovery and the indexing agent.
Indexing Agent. This agent traverses the Web site and indexes all relevant Web pages according to the dictionary and stores the results in the indexed database. The agent is responsible for performing full text indexing. It incrementally refreshes the indexes and automatically updates indexing. The indexing agent was developed using a script language that runs under the Windows NT environment.
Interface Agent. The interface is what the user sees. It was developed using the ActiveX technology. It presents a friendly interface that allows the user to interact with the system. The agent provides the user with the following functions: bookmarking of interesting Web pages on the Web site, navigation on the Web site, evaluation of retrieved Web pages, and the setting up of user preferences.
User Profile. The user profile consists of the user's account details, areas of interest, access history, and the rules generated by the discovery agent.
User Machine with Web Browser. A Web user can access the SiteHelper system through a Web browser that supports the ActiveX technology, for example, Internet Explorer or Navigator with the ActiveX plugs-in.

4. Incremental Learning and Discovery of Topics of Interest

SiteHelper learns about a user's areas of interests by carrying out two types of incremental learning: interactive learning and silent learning.

4.1 Interactive learning

SiteHelper interacts with the user through the interface agent. It allows the user to input a set of keywords as their areas of interest. The keywords are then used to match the keywords in the dictionary and a list of matching Web pages are retrieved from the indexed database through the discovery agent. The keywords are recorded into the user profile, and the user is requested to approve or disapprove each of the matching Web pages. With the approval/disapproval information, SiteHelper refines through the HCV engine the keywords of interest for the user. The approved Web pages are treated as positive examples (PE), and all others are negative examples (NE) of the user's areas of interest. The discovery agent then prepares a set of files and passes these to the HCV engine via the inter-link agent. HCV is then run on these examples to induce a set of rules describing the user's areas of interest and the result are returned and recorded in the user profile. SiteHelper continues performing the above cycle and improves its knowledge about the user. A detailed description of the rule generation process is given in Section 4.3 below.

4.2 Silent learning

SiteHelper extracts a log file for each user from the access log of the Web site. The log file keeps records of all Web pages that the user has accessed. SiteHelper treats these Web pages as positive examples (PE) and the rest of the Web pages at the Web site as negative examples (NE). Both sets of examples are then passed to HCV to generate rules. Rule generation is discussed in the next section.

4.3 Discovery of Users' Interests

The following is an example to illustrate how learning is carried out in SiteHelper. Suppose there are seven Web pages at a Web site with the following three keywords: Machine, Internet and Learning. These Web pages are represented in the table below where 1 indicates true (a Web page has this keyword) and 0 false. Assuming a user has viewed all seven Web pages and given approval to Web pages 2, 3, 5 and 7. The seven Web pages are then separated into two example sets: Positive Examples (PE) and Negative Examples (NE). As mentioned in Section 4.1, all approved Web pages are PE and the rest are NE.

Web Page (WP)	Machine (M)	Internet (I)	Learning (L)	Interested? (I?)
1	0	0	1	F
2	0	1	0	T
3	0	1	1	T
4	1	0	0	F
5	1	0	1	T
6	1	1	0	F
7	1	1	1	T

Positive Examples (PE)

WP	M	I	L	I?
2	0	1	0	T
3	0	1	1	T
5	1	0	1	T
7	1	1	1	T

Negative Examples (NE)

WP	M	I	L	I?
1	0	0	1	F
4	1	0	0	F
6	1	1	0	F

In the rule generation process, if a positive example's value (0 or 1) on a particular keyword is the same as that of a negative example in NE, then the negative example's value is replaced by "*". This indicates that the value cannot be used to distinguish the negative example from the current positive example.

- Let's begin with the NE, and add the 1st positive example

2	0	1	0	T

→

1	*	0	1	F
4	1	0	*	F
6	1	*	*	F

- Adding the 2nd positive example

3	0	1	1	T

→

1	*	0	*	F
4	1	0	*	F
6	1	*	*	F

- Adding the 3rd positive example

5	1	0	1	T

→

1	*	0	*	F
4	*	0	*	F
6	*	*	*	F

The 3rd row of the NE becomes all "*"s, and so we have to take the 3rd positive example out of this round of rule generation and in the next round of induction we will start with this 3rd positive example.

- We continue by adding the 4th positive example

7	1	1	1	T

→

1	*	0	*	F
4	*	0	*	F
6	*	*	*	F

Since the 3rd row once again becomes all "*"s, we have to take the 4th positive example out as well. Therefore, the resulting matrix for the first round is as follows.

WP	M	I	L	I?
1	*	0	*	F
4	1	0	*	F
6	1	*	*	F

⟹ This matrix says that "Machine <> 1 AND Internet <> 0". In other words "Machine = 0 AND Internet = 1". Therefore, the first rule generated for the user is the user is "Not interested in Machine" AND "interested in Internet".

Now we start the 2nd round of induction with the 3rd positive example.

- Add the 3rd positive example to the negative example (NE)

5	1	0	1	T

→

1	0	*	*	F
4	*	*	0	F
6	*	1	0	F

- Add the 4th positive example

7	1	1	1	T

→

1	0	*	*	F
4	*	*	0	F
6	*	*	0	F

The resulting matrix for the 2nd round of induction is as follows.

WP	M	I	L	I?
1	0	*	*	F
4	*	*	0	F
6	*	*	0	F

The corresponding rule is "Machine <> 0 AND Learning <>0". In other words, "Machine = 1 AND Learning = 1". Therefore the second rule for the user is that the user is interested in "Machine" AND "Learning".

4.4 Assist the user based on induction results

Interactive learning and silent learning both learn about a user's areas of interest. Learning results are given in the form of logic rules. When a new Web page is constructed and added to the Web site, or an existing Web page is modified, SiteHelper runs the indexing agent to identify a set of keywords to index it. The creation or modification date is also recorded in the indexed database. After silent learning and/or incremental learning has taken place, the discovery agent uses these keywords to match the HCV rules in the user profile to check whether it would be of the user's interest. When the user visits the local site again, SiteHelper lists all these Web pages that match the user's HCV rules and have been created or modified since the user's last visit. If the user disapproves some of these Web pages, incremental interactive learning is performed to improve the HCV rules.

5. Conclusion

This paper has presented our approach in addressing the increasing difficulty in retrieving relevant information on the Web by using a localized intelligent Web agent called SiteHelper. SiteHelper incrementally learns about the Web user's areas of interest and assists the user by matching what it has learned about the user, with the newly developed and modified Web pages. A detailed description of the architecture of the SiteHelper system is given and the rule generation process is illustrated with an example run.

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Network Architecture and Web Applications of a Scenario-engineering Laboratory

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Abstract: The paper introduces NET-SIMULAB (NETworked—Scenario-engineering Interactive MUltimedia LABoratory), a multitechnology laboratory which is intended to serve as an advanced technical aid to the trasformation of scenarios of business environments into an easy-to-learn knowledge for decision makers and strategic planners. Special focus is placed on the network architecture and possible Web applications, including the production of HTML (Hypertext Markup Language) pages for the World Wide Web, the creation of a scientific newsgroup on the Usenet concerning scenarios, and the realization of HTML forms for the Web to consult remote experts.

Introduction

Geo-strategic thinkers and business futurists are increasingly focusing on the importance of the advent of the wide area multimedia networking or, better, of the evolving global digital superhighway infrastructure. The technology scene is dominated by the huge planetary diffusion of the networked hypermedia World Wide Web [Nicolo' & Sapio 1997] which spans many operating systems platforms, protocols and types of data.
We could argue that human society is entering the "networked hypermultimedia" epoch which will generate novel advantages as well as new problems and risks. Given this rapidly changing climate, scenario modellers should entirely accept the technology challenge not only by including new items within their possible future landscapes (which is obvious) but also by integrating the above mentioned capabilities offered by technology within the process itself of scenario creation, from conception to delivery.

Scenario-engineering [Nicolo' & Sapio 1996] supported by adequate technical facilities can contribute to solving the problem under consideration. Scenario Engineering is a general corpus of methods and techniques of scenario analysis for strategic planning and pre-planning. These methodologies may be both interpretative and project-oriented. They are quantitative and/or qualitative and they may be both analytical and simulative. SIMULAB (Scenario-engineering Interactive MUltimedia LABoratory) is an auxiliary system of technological tools which is intended to serve as an advanced technical aid to the implementation of scenario engineering [Nicolo' & Sapio 1998].
This paper provides the main characteristics of the laboratory hosted by Fondazione Ugo Bordoni (FUB), which is named SIMULAB-FUB, focusing on its network architecture and possible Web applications.

Characteristics of SIMULAB

SIMULAB is an advanced work environment suitably arranged to carry out research activities in the field of Scenario Engineering and to handle multimedia information in an interactive way. SIMULAB is a laboratory for the integrated handling of different types of data and it is aimed at generating and analyzing complex scenarios to be presented using multimedia facilities. It is interconnected with the global telecommunications network, thus it is also called NET-SIMULAB (NETworked-SIMULAB).
SIMULAB is equipped with advanced processing, memory, presentation and communication devices, and it is made up of methodological, technical and infrastructural resources necessary to generate, analyze, store, present and transfer scenarios usable in an interactive multimedia way also from remote sites.

Scenario engineering can be carried out using methodological, hardware, software and infrastructural resources of SIMULAB. Five phases for scenario engineering can be distinguished: scenario generation, scenario analysis, scenario presentation, scenario communication and scenario documentation.
As regards the hardware configuration of SIMULAB-FUB, there are three main workstations. Workstation 1 and workstation 2 are basically used for scenario generation and analysis. Workstation 3 is used for scenario presentation and documentation. A portable workstation is used for remote elaboration and can be connected to fixed workstations. Additional hardware includes external mass-memory units, hi-fi devices, video equipment and digital photographic facilities.

Network Configuration

The three workstations are mutually connected in the local network through a star topology exploiting high speed links. Figure 1 shows a simplified configuration of the access of SIMULAB to the Internet via the FUB organization LAN (Ethernet). The three main workstations of the laboratory are connected to the switch located within the FUB Division of Telecommunications Evolution, then they can access the external router through a router/switch connected to the FUB LAN subnetworks. Figure 1 also shows the presence of the FUB Web server.

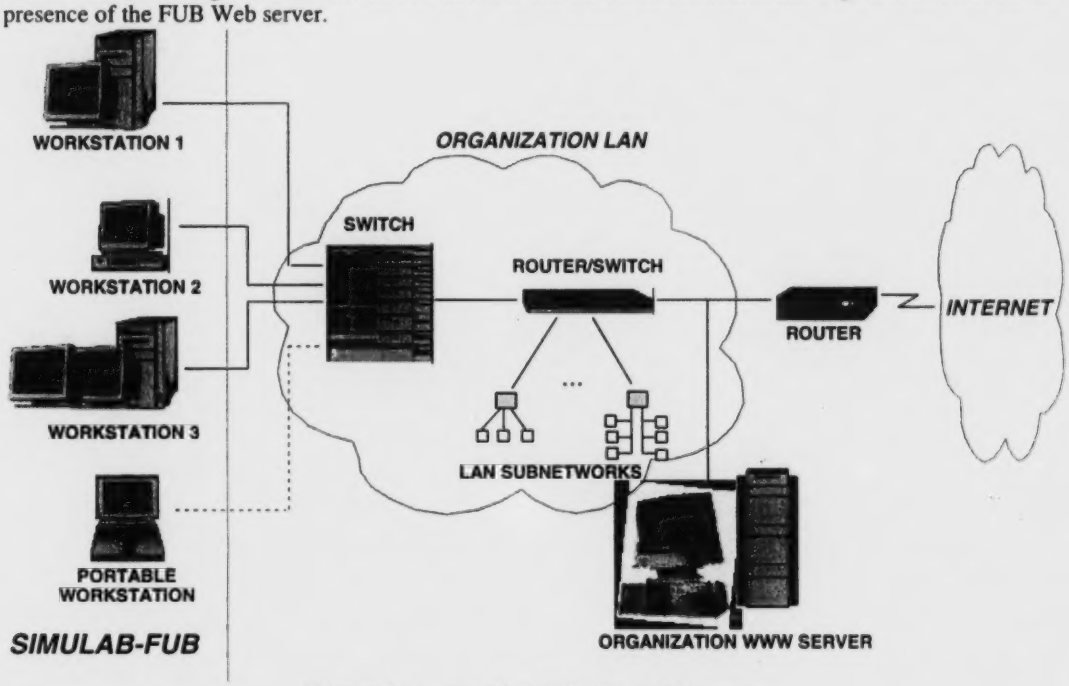

Figure 1: Access of SIMULAB to the Internet

Web applications

Examples of possible Web applications of the laboratory are listed below.

Production of HTML (Hypertext Markup Language) pages for the World Wide Web
These pages should include reference to activities of scenario building, a database of applications to different research fields, hyperlinks to scientific papers published in FUB and to worldwide organizations concerned with scenario analysis (forecasting, project management and operations research organizations).

Creation of a scientific newsgroup on the Usenet concerning scenarios
The newsgroup should provide a forum for discussion on scenario-related themes among experts belonging to different disciplines and geographical areas.

Realization of HTML forms for the Web to consult remote experts

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During the early phases of scenario engineering, it is often convenient to consult experts to collect their subjective opinions, both as qualitative and quantitative data. This operation could be performed exploiting the Web possibilities in order to be able to reach a greater number of experts in remote places.

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INFO: One Effort in Shaping Education for the 21st Century and Recognition of the New Literacy

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Abstract: Like other countries in transition, the Republic of Macedonia has started with reforms in the educational system. This system suffered from the old fashion way of teaching. Students are put in situations where they must absorb facts from their teachers or textbooks. This way they become a live "encyclopaedia", unable to solve real-life problems.
At this moment the community desperately looks for an "ideal education", that will use networking technologies. Almost all people involved in education are sure that the Net will improve quality in learning and will provide today's students with the skills necessary to accommodate themselves to the needs of the next century job market.
There are many projects held now in Macedonia. However, one of them is an attempt to find appropriate ways not only to improve creative and critical thinking among students, but also to promote the needs of today's community for long life learning, especially using the Net as a learning environment.

Current Educational Reform Should Comply With the Needs For 21st Century Literacy

The Propose of this paper is not to describe the whole project, but to focus on one part of the project. The project has started in Macedonia from September 1997 and is carried out under the authority of the Ministry of Education. Among other modern courses in the PROJECT for Experimentally Teaching in High School Education (PEKSNAS)[1], there is a course which makes direct contribution to the needs for the 21st century literacy, called INFO[2]. (INFO is the abbreviation from the word information). In this paper I am going to describe the concept of INFO, and its value not only for Macedonian education, but also for education in general. Actually, we can accept INFO as an attempt to introduce a new kind of literacy and as only chance we can provide for our youngsters, at this moment, in order to help them to prepare themselves for the jobs of the next century's market.

[1] Authors of the PEKSNAS Project: Cane Kotevski and Kiril Risteski
[2] INFO curriculum development: Cane Kotevski and Margerta Nikolovska

Why is INFO Important?

Until recently education as a system was mainly closed within the national boundaries of each country. The information technology has direct impact in shifting this limits of the education far beyond the national boundaries. The reason for the improved diversity, availability, competitively and accessibility of the educational system lies within the computer connectivity.

In these new circumstances, it is perfectly clear that traditional classroom can not give youngsters the skills they need for the future. The job market of the 21st century will be much more competitive then today and the need for flexible, problem solving oriented, and high-educated people is a demand of today's education.

The development of information technology and connectivity on the Net has impressive impact on education, and it seems that in the near future we will face a entirely new learning environment, accessible for people in every corner on Earth.

Every educational system, no matter if it takes place in a developed country, or in the poor part of the world, has several common features:

First, education is a uniform process. This is a guidance process in which step by step different teachers, from different scientific fields, in some way put knowledge in the head of the students."....the teacher or expert faces the learners, taking on the critical role of the "fountain of knowledge. "The learner plays the "receiver of wisdom," passively accepting the intelligence being dispensed, like an empty bowl into which water is poured. Education, in this view, is merely a conveyance of what experts already know to be true; it is not a process of inquiry, discovery, and wonder....." [L.J. Perelman 1992]

Second, education is a composition of independent subjects. The students during the regular school day have several independent lessons. They visit Math, Physics and History classes. They study in a fragmented way, subject by subject. Is this the way our brain thinks? The things are even worse considering that ".....typical curriculum design is based on a conceptual analysis of the subject matter that ignores - or assumes - what is already in the learner's head. But learners rarely come new and empty to what is being taught....." [L.J. Perelman 1992]

Third, from the first day of education in schools teachers always force their students to use the same books. All of them in the classroom learn using the same textbooks. Even talking about the individuality of the person, teachers usually use the same strategies for most of the students in the class, with very little exceptions.

All these facts, with the unlimited world of information on the Net; become an easy problem to solve for teachers. "Cyberspace" is making impressive changes in world of learning and education. With communications and new information technology, traditional classroom and school structure lose their significance.

Having "cyberspace" as endless source of knowledge, we can make one *big* step forward, and really make impressive changes not only in the student's education, but also in their future.

Thinking about all this, trying to find best solution for our students about using "cyberspace" and different knowledge bases for their education, we decided to set up one course, we called it INFO. The course is designed for a broad range of students. As a one-year course, INFO is designed to prepare students for long life learning, using "cyberspace" and different knowledge bases. We strongly believe that this course is going to change most of the problems, especially those that we have mentioned before as education's common features. After passing through this one-year course, we believe that:

First, the learning process does not follow one direction in the development of the idea, but on the contrary produces different outcomes for different students. Using different knowledge bases, no matter whether these bases are on the Net or on CD-ROMs in local computer, no one can learn in a uniform direction, because the INFO learning concept lies on an integrated environment. Materials available over "cyberspace" and CD-ROMs are a real treasure, almost limitless and always up to date. Only after a one year experience in PEKSNAS project with the INFO course, we noticed that the students used the experience from this course in almost every other course. It is obvious that no matter what topic they want to cover on the Net, the beginning of exploration is different for every student in the class. It is obvious that the "empty" student's heads are not equally empty. There are diversity in the background of each student in the class. As mentioned above this diversity in the student's background is completely ignored by a traditional education. We conclude that with INFO course, the diversity in student's background is stimulated, and in that way the desire for exploration, discovery and invention is also stimulated.

Second, as an integrated environment INFO forces students to learn in the correlated way. There is no line between Math, Physics and History. One year experience with the students in PEKSNAS project that are involved in the INFO class, clearly shows that in every student project, no matter what is the topic the project covers, there are interconnections between different subjects.

Third, INFO forces students to create their own strategies for learning, with no exceptions, no matter what they have to learn. Even the main goal of the INFO course is to introduce to students the basic concepts and applications of the Net, after a one year experience with the INFO students, it is obvious that the course has a positive impact in the process of creation of learning strategies for acquiring knowledge in all fields. Every student in the class will learn in the most adequate way for himself (herself), developing plans for learning the desired issue, according to his or her own knowledge, own needs, own ideas. So, if the students try to learn about a particular topic independently, according to previous knowledge and according to current interests, every student is going to develop his/her own strategy for learning. Of course, every student would spend an amazing time in the classroom.

INFO Concepts

Designed as a support for efficient use of the cyberspace for learning and education, this course is the first step to give students the new literacy they need for the 21st century market.
Thinking about the best way in which we can design INFO[1] , we decided to divide this course into three major parts:

First Part of INFO: Searching Different CD-ROM Knowledge Bases

This part of INFO is dedicated to provide students with ability to search different knowledge bases, like encyclopaedia, catalogues, etc. All education process in this part must take place in multimedia environment.
Because all CD-ROM's came with own searching software- INFO focus training of the students in these several directions: searching for key words; searching based on "knowledge tree" or category searching; searching base on time or location; searching base on multimedia elements (like pictures, video film...), browsing the knowledge base, wizard searching.
After learning these essential tools for searching knowledge bases, students learn how to combine those tools, for making useful searching any kind of knowledge bases. New terms will be learned by students with the help of an INFO teacher. This part of the INFO course is very important because here students become familiar with "locating" information on any sort of knowledge bases. The main training here is a focus on "locating" the information the reader needs, and only what he/she needs. I believe that this will be a crucial skill needed for the next century market. Here is one example:
Monday, 10 May 2010, 8.00 am, World Bank Mission Office in Macedonia
The employee in World Bank Mission in Macedonia needs information about the activities of the Mission in June 1998 in North America. The most reliable resource is Library of Congress in Washington, DC available on one huge stack of CD-ROMs, accessible through the NET.
Billions of pages of other information available, beside the particular one this employee is looking for. Can this employee find what he/she need *and only what he/she need,* but *in reasonable time*? Of course, but only with appropriate training. So, the first part of INFO course is introduction in development of "searching" skills.

Second Part of INFO: Learning About All Services Available on the Net

In this part of INFO we decided to introduce students to the world of endless information, starting with making effective connections through world. Here they learn about different services available on the Net, like Telnet, Ftp, e-mail, etc. Also, the most important thing that they learn in this part is to use the WWW, how they can retrieve information with the WWW-browser, etc. We make selection of the best search engines available today, and develop lessons how to learn to use and combine various search engines. Also we develop special searching strategies for different engines in order to quickly retrieve information. This means that it is very useful when the student in a very short time finds the most appropriate searching string. Because we really think that for today's youngsters it is very important not only to be a successful navigator through "cyberspace", but also to be able to publish one's own ideas and work in "cyberspace", so in this part of the INFO course students learn about HTML programming, using the best available programs today. Here, they can also apply all the knowledge from the first part of INFO. This part of the INFO course is an introduction to the development of skills about behaviour in a new growing society.

Third Part of INFO: "Cyberspace" for Learning and Education

This part is most important part of the whole course, because here students learn how to use all valuable services for their education. Keeping in mind that isolated information is not education; this part is the introduction to the self-learning environment for the entire life for every student. Simply, here students "learn" how to learn using "cyberspace". Different problems are simulated and different strategies for learning; using "cyberspace" are promoted. Locating different projects on the Net and combining them, mailing list and subscription, visiting different virtual libraries and using brand new information for desired issues, are describe in this part of INFO.
Part of INFO, that is called using "cyberspace" for learning and education, is imagined as a connection between "to be informed", and "to became educated". This means that all learned tools in the first two parts of INFO, now every student has to apply, "to become educated".

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CLASS-Using Innovative Technologies For Distance Education

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Abstract: The CLASS (Communications, Learning, and Assessment in a Student-centered System) Project is creating an accredited high school diploma sequence for delivery on the World Wide Web. Because of the unique distance learning environment of the Web, the CLASS Project has developed an instructional design model specifically for the Web. Coupled with the instructional design model, CLASS has created Web-based instructional design features to maximize the learning opportunities afforded by this electronic education environment. Both the CLASS design features and instructional design model are transferable and scaleable to the needs of other distance learning programs.

The Project

The CLASS (*C*ommunications, *L*earning, and *A*ssessment in a *S*tudent-centered *S*ystem) Project's goal is to make available on the World Wide Web a complete, accredited high school diploma sequence. The Department of Distance Education of the University of Nebraska-Lincoln (UNL) is recipient of $18 million in federal funding to develop the sequence. When completed in 2001, CLASS will have available to students 54 courses from which to choose to complete their high school graduation requirements.

The Department of Distance Education is uniquely suited to provide this diploma sequence. Among its units is the Independent Study High School (ISHS). The ISHS is the only university-based, fully accredited, independent study high school in the United States. In operation since 1929 and accredited by both the North Central Association of Colleges and Schools (NCA) and the Nebraska Department of Education (NDE), the ISHS currently serves about 15,000 students annually in 136 countries. The students can choose from among 138 print-based courses in addition to the CLASS electronic courses. Enrollment is open, with students registering throughout the year.

The uniqueness and long record of success of the ISHS was recognized by various government funding sources. Beginning in March, 1996, the first funding for the CLASS Project was awarded for proof of concept by the federal General Services Administration. In July, 1996, the ISHS was notified that it had been awarded a U.S. Department of Education Star Schools grant. This was a five year win with first year funding, beginning October 1, 1996. Other funds for the technology invention side of the project came from various components of the United States' service community, including the Central Intelligence Agency and the National Reconnaissance Office.

The Courses

The development of the courses for this project required the recognition of several factors. Paramount among these was the fact that the World Wide Web offered a new and different educational delivery method. Therefore, current print-based courses could not simply be transferred to the Web. Second, in order to fully utilize the potential of the Web as an educational delivery system, there would need to be new software and technologies developed. Third, and premised on the first two points, production of these courses would take

place in a manner different than traditional multimedia production. To put it simply, the project would require invention in both the areas of instructional design and technology.

CLASS is a dynamically interactive, student-centered course environment delivered electronically via the World Wide Web. Students access moving imagery, graphics, sound, and text within a seamless navigational system that encourages individualized learning, discovery, and exploration. "Seamless" means that students do not have to open and close applications to move from, for instance, a text screen to simulation (or to a video or discussion group). The technology for supporting all the media of a course is included in CLASS.

CLASS provides new avenues of educational access through cost-effective alternatives to conventional classroom teaching situations. These new avenues are particularly important when reaching out to all levels of students, including non-traditional, geographically isolated or disadvantaged, at-risk, and gifted. CLASS provides individual learners with access to interactive, flexible course materials, including data, graphics and video, and incorporates electronic interaction between learners and instructors. CLASS helps students manage this multitude of materials by providing an electronic "notebook" where students can store and sort everything from video to text. In the "notebook" students can take computer-graded objective assessments, write essays, and design multimedia portfolios. Graphics can be added to their assignments simply by dragging and dropping them into their notebooks, including audio and video files. They can share this information with other students or with the teacher.

Courses are formatted especially for electronic delivery. Students are responsible for their own learning, making choices in the paths they take through course units and selecting from many different learning activities and experiences. The units of a course develop increasing levels of complexity and sophistication within the course content. As students move through the units, their interaction with the materials requires an ever-widening understanding of the concepts being presented. Students determine their own mastery of the material by taking practice exams that are electronically evaluated; students receive the results in only a few seconds. Examinations and projects are evaluated electronically or by the teacher.

CLASS courses are developed utilizing a toolbar that has a standard look and functionality, easing the student learning curve from one course to another. In addition to using the toolbar, the student has a variety of navigational tools. The student can access course content via layered geographical maps--a course outline or embedded navigational prompts, which include directions that help the student maintain a sense of place.

The opening page or splash screen includes fast links to a variety of important information. A *Netscape for New Users* section helps the inexperienced or reluctant computer user become familiar with the Web learning environment. The *Help* and *Course Guide* sections provide the student with course-specific learning strategies and answers to user-related questions. An *Introduction* orients the student toward their expected experiences and outcomes.

The *Grade Report* gives the student and teacher the opportunity to monitor progress. Password secured, the *Grade Report* displays a complete list of course assignments, grades for completed assignments, and an accumulated grade.

CLASS instructional design provides for the interaction between learners and instructors, stressing the development of life and workplace skills, citizenship responsibilities, and critical thinking. New technologies provide learners with access to digital libraries from national, historic, scientific, and research centers over the global and national information infrastructure.

Conclusion

The CLASS instructional design model is a work in progress, regularly revised and revisited. It is used for developing all CLASS courses and easily transfers to a variety of Web-based instructional needs. Whether one is developing a single lesson tutorial or an accredited semester-length course, the CLASS instructional model is sizable to the situation.

CLASS instructional design features give distance education students the opportunity to learn using a myriad of tools that are unique to Web-based education, including student-to-student communication, dynamic learning activities, student-selected learning paths, multimedia-reinforced learning, self-monitoring of progress, and the ability to create multimedia portfolios, all in a seamless learning environment not bound by time nor space.

Because of its size and scope, the CLASS Project has the potential to revolutionize the distance delivery of courses to individual students, learning centers, and schools that cannot or do not have the ability to offer specialized courses such as English as a Second Language.

Currently twenty courses are available for enrollments. Course examples, along with additional information on CLASS can be found at http://class.unl.edu.

Electronic Commerce - An IS Perspective

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Abstract: The Internet is revolutionizing the potential reach, appeal, and capabilities of electronic commerce. Setting up shop on the Internet is relatively simple. But, for businesses that would like to be more than a booth in the cyber flea market, considerable resource commitments are required to plan and execute a viable online commerce strategy. People and technology resources are two of the ingredients that play a vital role in the administration of electronic commerce. This paper examines some of the issues surrounding the organization of these key resources that are relevant to a company's quest for commercial success on the Internet.

1. Introduction

The ubiquity of the Internet, and its vast potential as a communication medium has enormous appeal for both consumers and vendors. Originally conceived as a non-commercial conduit for knowledge exchange and dissemination, the Internet within a span of less than five years is being revolutionized into a global marketplace. Commercial success on the Internet is far from being assured, and every functional area and every hierarchical level of a business are faced with finding answers to a number of strategic and operational questions. This paper discusses some key issues faced by the IS group in organizing staffing and technical infrastructure to facilitate a company's presence on the Internet's commercial spectrum.

2. Staffing Issues

In addition to the technical personnel involved in the process of creating and maintaining a commercial Web site, the following are some of staff positions that [LaPlante 1996] suggests will have to be created to support electronic commerce:

- *Content Developer* – Provides the raw material that makes a site worth visiting.
- *Content Editor* – Makes sure this material is accurate, current, unduplicated and positioned correctly.
- *Copy Editor* – Keeps content clean of spelling and grammatical errors and ensures consistency with corporate culture and image.
- *Interface Design/Manager* – Ensures that the Web site is easy to navigate.
- *Electronic Marketing Manager* – Gets the customers in the door of the site.
- *Web Evangelist* – Surfs the Web to check out competition, raise awareness, keep on top of new ideas.
- *Web Support/Manager* – Answers user questions. Provides feed back to Interface Designer/Manager.
- *Quality Control Manager* – Ensures that interactions with customers meet corporate standards. Polices departmental accountability for returning e-mail, answering queries.
- *Net Wizard* – Knows the "next hot thing" about Web technology.

The above list highlights the need for a number of non-technical professionals to substantially supplement the traditional IS organization. The skills required for successful electronic commerce are varied and mandate the active cooperation and mutual sharing of resources among multiple departments. It is also abundantly clear that traditional functional silos are organizationally unfit for creating and conducting Web business.

3. Technical Issues

The technical infrastructure needed for electronic commerce appear to be relatively simple. However, the bewildering array of options available to a company tend to somewhat obscure the technical

process of establishing a functioning on-line commercial site. Some key issues that are relevant in the organization of electronic commerce are discussed next.

Establishing contact - This step involves a potential customer visiting a Web site. The site can insert another layer of access control by requiring a specific log-on procedure mostly in the form of a username and password. There are both positive and negative aspects to this additional access control feature. The positives include better customer tracking, analysis of trends, heightened security, and customizable interface. The negatives are a) one more login and password for users to remember, b) many users like to browse anonymously, and c) increases online time for dial-up users.

Search for product/information and selections of product(s) - There are two components of importance at this juncture. These are the interface and the back-end system. The interface refers to the web pages including content, form, appearance, and navigational tools that the visitor perceives and interacts with at the site. The back-end system that is found at this stage is typically the content server. The content server stores the information that will be "served" to a client that requests information. The interface to the search and select process is analogous to catalog shopping. Therefore, the extent of existing catalog digitization and its capability for integration to a Web platform are critical issues. The key necessity is appropriate software on the servers to extrapolate information from the current product databases, format the data correctly, and then allow the Web server software to make the pages available to the general public.

Order placement, processing, and confirmation - The order data that is received through the web interface should be directly integrated with the vendor's existing order processing system to expedite the transaction and prevent unnecessary re-keying of data.

Payment Processing - In the context of electronic commerce there are some real and mythical problems associated with ensuring security of transactions related to the transmission and storage of credit card information. Security concerns are being met by Internet standards such as public-key encryption techniques and secure sockets layers (SSL) on both the browser and server software. Besides encryption, a number of alternative forms to handle payment transactions including digital cash are being tested and refined.

Shipment and receipt of products - One way in which businesses can add value to the online buying experience is to allow users that ability to track their packages en route. Many companies do this by giving a routing number for the particular courier that they may use (UPS, Federal Express, etc). In addition, customers can directly download certain intangible products such as computer software after payment authorization is received. Other services that may be offered is a "buying history" page that users could access to see their purchase records. If user information like buying history and product preferences can be stored in databases; the business also has the opportunity to further customize the experience for a particular customer.

4. Conclusion

The IS function can play a proactive role in shaping Internet commerce strategy and in its administration. But, to be a productive partner in a company's Web venture, the IS management team should recognize the criticality of multi-disciplinary staffing needs. In addition, it is vital that the IS team effectively communicates to the rest of the organization the demands on existing technical infrastructure and the impact of needed modification that may alter or disrupt the flow of traditional IS services. Tapping the Web for commercial rewards is clearly not a techno-centric adventure. However, it will be perilous to ignore the pervasive role of technology in the functioning of today's organizations.

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A Proposed Contingency Model of Distance Learning: What Have We Learned So Far?

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Abstract: This paper examines what we have learned so far in distance education technologies and how we can use them in the classroom. Different learning styles and course content call for different styles of teaching, both in the classroom and through distance technology. A brief model is given.

1. Introduction

Distance education has become more popular as universities and colleges have tried to find more ways of meeting their constituencies' needs, including students, legislators, administrators, and the general public. As budget pressures have increased, administrators and faculty have tried to be accommodating by offering more distance learning classes. However, the problems with offering courses by distance education technologies were not obvious at first. These problems are surfacing at universities across the country and the world and are being solved through hands-on experimentation. These experiences have been made public through publications in various academic journals.

A contingency model offers a prescriptive approach to a problem. A contingency model in distance learning offers a prescription for what should be done in a particular situation. This paper begins with the content of the course and then proceeds to the types of distance learning technologies that might be most appropriate.

II. Types of course material

According to Leidner and Jarvenpaa (1993), there are four types of course material: factual, procedural, conceptual, and exploratory [Fischer & Grant 1983]. Factual material, essential in most subjects, is often emphasized and higher-order learning, such as that found in conceptual and exploratory material, is often ignored in traditionally taught courses. Leidner and Jarvenpaa (1993) come to the conclusion that although active involvement in the learning process is critical and leads to a greater likelihood of creative and critical, as opposed to factual, thinking the incidence of this happening in traditionally taught courses is actually lower than in computer-based courses.

The conclusion that higher-order learning might occur more frequently in computer-based courses rather than traditionally taught courses is a dangerous one. Instructors and administrators may be tempted to offer courses via distance-learning technologies and point to these studies as evidence that the experience is as rich, or, as Leidner and Marvenpaa concluded, even richer than traditionally taught courses. These assumptions ignore the emotional and physical distance between instructor and students during a distance learning course, and also ignore that the distance learning technology is only a tool. The effectiveness of the technology depends upon the instructor's expertise and skill in teaching, as well as the proficiency in integrating the technology into the learning experience in a way that is appropriate.

III. Matching course material with appropriate activities

There are many types of distance learning technologies available: videostreaming, television courses, correspondence courses, Web boards and World Wide Web based courses, just to mention a few. All of these technologies have different strengths and weaknesses; some technologies are quite reliable and others are not; some offer opportunities for synchronous interactions and others offer asynchronous interaction. Depending upon the type of material that is offered in the course and the outcomes desired, some technologies are more appropriate.

The contingency model proposed is not intended to explore the details of the technologies available. The rate of change is so rapid in technologies, that making suggestions based upon specific technologies would be soon obsolete. Rather, this paper proposes a more general contingency model.

Rather than using technology as a way to transmit course content as it would be delivered in a traditional classroom, the instructor needs to find a way to use the technology's inherent characteristics to best capture the student's interest. Reading off lecture notes during a videoconferencing session may not be the best way to deliver the material, even factual material. Students become distracted by the technology, feel less connected to the instructor and the course, and become disinterested in the course. This is not a learning event, but rather, a one-way discourse on the material.

Instructors need to leverage the strengths of each of the technologies and match them with the type of material and the characteristics of the students. For students who are especially comfortable with the technology, a technology-based course might be especially interesting.

Material	Type of distance education technology
Factual	Correspondence; e-mail; videoconferencing; television courses; any technology that requires only a one-way delivery of material
Procedural	Correspondence; e-mail; videoconferencing; television courses; any technology that requires a one-way delivery of material and some clarification of the material
Conceptual	E-mail; two-way videoconferencing; Web-based courses; any technology that allows synchronous or asynchronous delivery and discussion of material and activities
Exploratory	E-mail; Web-based courses; videoconferencing; any technology that allows for intense discussion of material and activities

Table 2: Types of distance education technology

In conclusion, the contingency model that is just suggested in this paper needs to be developed further. The type of material in the course, the type of technology, and the students' characteristics need to be examined in order to develop an effective course. The goal should be to develop as rich a course as possible, with the technology used as a tool. Just delivering the course material isn't enough in today's high-technology world. Creating activities and opportunities for interaction is the best way to teach in a traditional classroom. The challenge now is how to use distance education technologies to accomplish the same goal.

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INTERNATIONAL ISSUES AND DEVELOPMENT

INTERNATIONAL INTERNET COLLABORATION: MOREHEAD STATE UNIVERSITY AND BEIJING TEACHERS COLLEGE OF PHYSICAL EDUCATION

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ABSTRACT: Morehead State University (MSU), Morehead KY and Beijing Teacher's College of Physical Education (BTCPE), Beijing, China have established a collaborative learning and research agreement in the areas of sports administration and sports nutrition. The following describes the development of the relationship between the universities, and of interactive web-based learning environments with regards to educational delivery and research plans.

Representatives from several Chinese universities initially visited MSU campus in April 1997. An agreement was approved whereby professors from MSU were invited to lecture at BTCPE campus during May-June 1998. The areas of instruction included sports marketing and sports nutrition. Upon arrival in China, the professors from MSU determined that the collaboration between MSU and BTCPE could be enhanced through implementation of web based technology. The intent is to develop student interaction amongst peers to understand cultural differences within subject areas. In addition, the possibility of research using the above aforementioned technology between professors at the respective universities will be developed.

The following outline describes specific planned activities in sports marketing and sports nutrition between MSU and BTCPE for 1998-2000 for student education and for research. The educational goal is to engage students at the respective universities to exchange views related to their disciplines. Interactive classes will utilize web-based courseware between introductory courses in respective subject areas (discussion threads and virtual chat). Professors from MSU and BTCPE campuses will jointly provide input to the topics reviewed and discussed by students enrolled in the courses.

From a sports marketing perspective, the following research areas will be investigated utilizing web based instruction: sports job prospects, sports internship possibilites, sports sponsorship, agency system, and international placement. The advantage of using interactive learning technology for this process is that it allows investigators to interact with few constraints from distance, time, and language barriers.

From a sports nutrition perspective, research related to nutrition assessment and analysis of Chinese athletes will be conducted. The advantage of using web based technology for this area is that it allows exchange of data between investigators at MSU and BTCPE collected at respective universities without the same constraints addressed above.

The use of web based technology for educational research purposes between United States and Chinese universities in the areas of sports marketing and sports nutrition is a unique concept. Utilization of this concept will bridge the gap that currently exists with international education.

Meeting Critical Teacher Shortage Needs In Special Education Through Distance Learning

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Abstract: The critical shortage of special education teachers is one of the main forces driving the expansion of university personnel preparation programs. One creative approach is to deliver training over the Internet. This approach may provide a partial solution to the problem of teacher shortages, but it creates another problem: most university professors do not have the training and expertise to develop and deliver web-based courses. The University of Central Florida addressed both problems by providing "just-in-time" training to faculty. The training allowed faculty to continue their own professional development while at the same time building the human infrastructure for future web courses.

Special education teachers are in high demand but short supply. Nationally, approximately 10% of the 300,000 people who are teaching in special education programs lack certification in the area in which they are teaching [Blackhurst & Hale in press; Boe, Cook, Bobbitt., & Terbanian, G. 1998]. Because some school districts in Florida have as many as 50% out-of-field special education teachers, the state legislature has designated some special education certification areas as having "critical shortages." Teacher education programs have not been able to produce enough teachers to fill this great demand. One of the major challenges is how to deliver university coursework to non-certified teachers already teaching special education students [Blackhurst & Hale in press].

The University of Central Florida (UCF), one of 10 universities in Florida's state university system, is working to ameliorate this problem. Specifically, UCF seeks to offer more graduate courses in the certification area of Varying Exceptionalities because this certification allows teachers to serve three of the most critical shortage areas (specific learning disabilities, emotional handicaps, and educable mentally handicapped). UCF has several area campuses and its service area covers nine counties. Area campuses have limited resources and potential students in outlying areas are often discouraged from taking certification courses because of the long drives. Offering a World Wide Web (WWW) course was proposed as one approach to help address these barriers.

There were UCF exceptional education faculty interested in web-based and web-enhanced instruction, but they lacked the knowledge needed to design and deliver web-based instruction. When the leadership at the University sent out a request for proposals for funds to develop web-based or web enhanced courses for the 1998-99 academic year, the authors applied for and were awarded funds to develop a web-based course.

About the Course

The first fully web based exceptional student education course to be offered at UCF will be *Exceptional Children in the Schools*, a course required for certification in Varying Exceptionalities. This course teaches characteristics, definitions, educational outcomes ,and appropriate educational programs for exceptional children in schools. The target student audiences for the course are (1) individuals seeking a Master of Arts degree in special education and (2) out-of-field teachers who wish to be certified in Varying Exceptionalities. As an introductory course, the content of ***Exceptional Children in the Schools*** is especially appropriate for the web-based delivery format. For example, students are required to

know about a wide range of special education programs, service delivery formats, legislation and litigation. With guidance, the Internet can be a rich resource for students in these areas. Students will have the opportunity to share information through electronic communications with their fellow student. The perceptions students have when they go into classrooms to observe special education students can be posted as reflections on an electronic bulletin board. Technology is now widely used with special needs students themselves and this course will allow aspiring special education teachers to have some hands-on experience that should result in a greater comfort level in using technology with and for their own students. The two greatest challenges of offering a web-based introductory course in special education were: (1) the amount of new technology the instructors would have to learn and apply in a short period of time, and (2) how to keep the "high touch" aspect of training teachers to work with students with disabilities in the "high tech" delivery format.

About the Training

Recipients of the university web course development grants were required to take a "course" in order to receive their funding. The university's Division of Information Technologies and Resources, Unit of Course Development developed IDL6543 (Interactive Distributed Learning) to prepare faculty to teach on-line or media enhanced courses successfully. The course was simulation of a media-enhanced course that would gave faculty opportunities to work with the materials and tools just as their students would soon be doing. The course content consisted of on-line instructional modules, seminars, and labs. The 10 on-line modules covered the following topics: *Overview of Asynchronous Learning, Instructional Best Practices - Using Technology, Systematic Design Process, Course Development - Policies and Procedures, Interaction, Assessment, Course Administration, Group Work, Copyright Law and Fair Use, Learner Support*. Frequent contact and interaction with the instructors and other faculty in the course were encouraged. Faculty were provided with e-mail address (separate from the regular campus e-mail); and there were several forums on which faculty could post ideas or reactions to assignments and quizzes. Faculty could also make appointments with the course development team for technical support (e.g., setting up their course web sites) or with the Office of Instructional Resources for video or audio materials.

Seminars were offered on seven consecutive Friday mornings. The seminars provided participants with a variety of learning experiences. Faculty had opportunities to see examples of previous web-based and web enhanced instruction and to participate in small group discussions with other faculty (some with prior web experience and some developing web courses for the first time). The afternoon labs followed the seminars. The labs provided hands-on practice using the technology faculty had read about in the modules, heard about, or seen demonstrated in the seminars. The labs covered web browsing, WebCT: (computer mediated communications and administration features), advanced web searching and advanced GroupWise. Becoming students again, especially outside our usual areas of expertise, was an humbling and eye-opening experience. We often found ourselves saying some of the same things we have heard our students say, such as "That quiz question I missed was poorly worded", "I was late to class because I couldn't find a parking place."

The importance of faculty development in delivering instruction in new technology formats cannot be underestimated [Daigle & Jarmon 1997; Lawrence 1996-97]. A web-based *Exceptional Children In the Schools* at UCF would not have been possible without the "just in time" training offered to faculty. During the training, we learned many of the technical aspects of designing and delivering web-based and enhanced courses; we learned that we could not use the new technologies to deliver coursework in traditional ways [Duchastel 1996-97]. Perhaps the most important lesson we learned was that by being creative, we could have the high tech and high touch, too: our students will locate a person with a disability and develop a penpal relationship using the Internet!

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PaperFinder: A Tool for Scalable Search of Digital Libraries

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1. Introduction

The invention and spread of the World Wide Web made the process of paper publication significantly easier than before, and added a large repository of on-line (electronic) papers to our body of knowledge. To make the process of information gathering easier for scientists, Digital Libraries usually maintain Search Engines, which can be used to find papers about a specified topic. However, the use of these Search Engines suffers from two significant disadvantages. First, the user cannot guide his query to the Search Engines of different Digital Libraries at once. The same query has to be sent to several Search Engines in order to retrieve papers from conferences/journals organized by different institutions. Second, Search Engines do not keep track of the documents retrieved during a previous issue of the same query. Thus, every time a query is issued by a user, (almost) the same results will be returned to him.

In this project, we use the basic concepts behind the implementation of USEwebNET [Markatos 98] in order to face the problems described above. In the rest of this poster paper, we will describe PaperFinder, a tool that continually searches digital libraries of scientific publications, filters only the relevant papers, and delivers them to interested scientists through a friendly user-interface.

2. Design - User Interface

The purpose of PaperFinder is to provide the user with a flexible tool, able to simplify the time consuming task of information filtering. To achieve its purpose, PaperFinder has been designed as an added-value service on top of several Digital Libraries. PaperFinder's most important characteristics are the maintenance of a personal profile for each user of the system and an innovative filtering algorithm for the results of a query.

The basic idea behind PaperFinder is the ability to maintain information about a user's interests, and query several digital libraries for new articles in regular time periods. A query may be specified by a set of keywords, which characterize the user's topic of interest, the names of authors, whose articles the user is interested in, a date (the oldest publication date the articles of interest could have), and the Digital Libraries the query should be directed to. PaperFinder keeps track of the articles found for every topic of interest, so that a paper that has already been viewed and approved or rejected by the user will never be presented to him for a second time. While examining the papers retrieved by a query, the user has the ability to read their abstract or full text, if these are available, and save those that are especially interesting in separate folders. In addition to the above, the system maintains information about the current status of each paper retrieved. Specifically, an article may be marked as *Rejected*, *Read* (if it has been viewed at least once) or/and *Saved* (if it has been saved to at least one folder). After a paper has been marked as rejected, it will never be shown to the user again.

The interface of PaperFinder consists of three basic options:

- *Setup:* View existing queries, create a new query, or modify/delete an old one.
- *Results:* View new papers found for each query, and make several operations on them, like reading, saving and rejecting (Fig. 1).
- *Folders:* View the contents of selected folders.

Figure 1: Results of a query about "distributed systems" in the on-line digital library of the USENIX Association.

The back-end of PaperFinder consists of three cooperating modules. The first module is responsible for contacting the Digital Libraries and retrieving the results related with each query. These results are saved in separate internal files. The second one updates the profile of each user. Specifically, it compares the new articles with those already found in the user's profile. If a paper does not appear in the profile, it is added as a new one. Finally, the third module is responsible for sorting the new papers. The new papers are sorted according to one or more seed papers (or authors), which may be specified optionally by the user when creating a query.

PaperFinder works in two modes: the keyword-based mode and the resource-discovery mode. In the keyword-based mode, users simply supply PaperFinder with a few keywords that describe their field of interest, like "process scheduling". In the resource discovery mode, the user presents one or more "seed papers" and expects PaperFinder to discover new papers that are related to the seed papers. Paperfinder uses query generalization and filtering to discover papers related to the seed paper(s):

- *Query Generalization:* The goal of this step is to find several papers that are (more or less) related to the mentioned seed paper. To do so, PaperFinder forms queries by taking one keyword from the seed paper's title and searching for it, or, by taking (each) one of the co-authors and searching for papers co-authored by him (her), and merges the results.

- *Filtering:* The goal of this step is to filter the papers, found in the previous stage, and return the most relevant to the user. To find relevant papers, PaperFinder applies multiple similarity metrics to the papers found to measure how similar they are to the seed paper. Our intention is to define (and experiment with) several search metrics and present the users with a choice of the most promising ones.

3. Conclusion

To conclude, PaperFinder is a useful information filtering tool because it capitalizes on the familiar and effective user-interface of USENET news and maintains user-profiles. It also exploits search engines of Digital Libraries in order to find out *new* information, helping users in their research, reduces information pollution by not repeating previously read papers, and reduces the network congestion and server load by running and updating databases periodically (and preferably) at nights.

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Socialization of Distance Education: The Web as Enabler

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Abstract: The World Wide Web (WWW) has allowed the delineation of distance versus place-based education to become a *spectrum* rather than a binary choice. This paper discusses a novel format of distance education, namely 'Vitrual Seminars,' and their relation to issues within Cognitive Flexibility Theory. Virtual seminars are interactive courses offered over the WWW with a weekly term structure and a strong participative component. A particular course is offered as an example, and a vignette concludes the paper outlining how a student interacts with that course.

Introduction and Overview

Distance Education is coming of age. Historically, as a correspondence medium, it provided an alternative to other forms of educational delivery because of its flexibility in time and place. Criticism of the correspondence medium, however, stems from its inability to provide opportunities for meaningful interactivity between instructors and students in ways interwoven with the course materials. Now, however, distance education can offer an educational opportunity that works every bit as well as a place-based format, with some superior opportunities such as the abililty for a student to provide regular, significant feedback. A key advantage to a place-based offering has been the opportunity for students to interact with faculty, teaching assistants, and other students. This improves such skills as presentation and debate, and provides a rewarding social opportunity for all participants. Computer-based teaching and learning can be highly interactive as well, but unfortunately, it still tends to share a sterile image with the correspondence-based medium of instruction. In our observation, this is not so much due to the Computer medium itself, but rather to the perceived importance of face-to-face interaction. We argue that direct positive experiences of computer-mediated communication (CMC) quickly puts outworn perceptions to the test.

New developments in interactive technologies are blurring the lines between place, time, and distance and in doing so are mitigating the need for in-person communication. Two notable examples of this are video-based lectures, where students meet in smaller groups in satellite videoconferencing facilities, and virtual seminars, where students participate in computer-mediated environments using the world wide web and various special software packages, such as multimedia browsers and chat facilities. These developments signal a neat transition from reliance on face-to-face instruction to increasing acceptance of the viability of multi-media-based instruction, particularly over the Web. See, for example, the section entitled '*Concluding Vignette*' which uses the example of one student to show how changes in distance education facilitated by the web positively impacts students' learning experiences. Students involved with online instruction have access to a variety of tools and techniques that allow implementation of instructional design features that enhance the flexibility, interactivity, and social aspects of the learning process.

In this paper we describe how a rich fabric of social activity is integral to the design of a Web-based upper-level university Business course on "Information Analysis and Systems Design" in ways that enhance teaching and learning by extending and enriching the social nature of the learning experience. To do this, we designed the course through the "lenspiece" of cognitive flexibility theory, a derivative of constructivist principles of learning.

Constructivist theories assume one unifying principle: That is the assumption that truly meaningful learning

arises from students' active engagement in shared learning experiences (Brown, Collins, & Duguid, 1989; Lave, 1988). This assumption underscores both theoretical and practical efforts to capture dynamic interactions between the cognitive and social dimensions of learning (Resnick & Collins, 1996; Salomon & Perkins, 1995). The business course focuses on telecommunications applications for the corporate and private sectors. Undergraduate students who take it typically have little work experience and thus require opportunities to practice new learning in cases that reflect the complex nature of the workplace itself. For instructional design purposes, we use the precepts of cognitive flexibility theory, adapted from Spiro, Feltovitch, & Coulson (1996). These precepts emphasize strategies designed to enhance complex learning through multiple representations of new information anchored in particular contexts. In this case, students are given opportunities to acquire rich semantic networks of information and the ability to structure and restructure new and prior knowledge in activities designed to anticipate the demands of variable and changing situations encountered in the workplace.

Tools for Interactive Communications

Virtual seminars are supported by conferencing software. A student enters this course through software such as FirstClass (FirstClass Systems) or Virtual-U (Simon Fraser University) and can read lectures written in the multimedia environment of HTML, link to resources on the web, and participate frequently. If a student is required to participate weekly, for example, (s)he can typically contribute a comment which could take five to ten minutes to contribute in a place-based seminar format. Comparatively, if each of fifty students were to make such a contribution, a weekly time allotment of over four classroom hours would be required simply for student comment in a place-based setting. This is a three credit hour course.

With the interactivity available through the WWW, a distance education course like this can be run in a lock step format where the course is offered in a week-by-week format. This allows for interactivity among the students and allows for the professor and/or teaching assistants to be available over the duration of the course. Since the interactive format allows for better student input than either its correspondence-based predecessor or the traditional classroom setting, it is possible to evaluate student participation in more meaningful ways. A key advantage of the virtual format is the ability to archive every conversation that takes place and thus more objectively evaluate the frequency and quality of students' contributions.

To support such a course, students need access to opportunities to discuss issues and ask questions of the professor, teaching assistant(s), and other students. Electronic mail is sufficient for many of these dialogues, but a chat facility allows for group discussions and some social interaction. The Palace (http://www.thepalace.com) is an example of a tool we use to develop a virtual meeting place (See, for example, the Simon Fraser University instance of the Palace used for on-line courses designed by Brent DeWaal at http://www.sfu.ca/~dewaal/palace/palace.htm).

The Analysis and Design of Business Information Systems

Structure, Organization, and Process.

The course outlined in the '*Concluding Vignette*' is a business administration course introducing students to the roles and techniques supported by a Systems Analyst. The course was offered using the Virtual University Toolset (SFU) in the Spring term of 1997 to a group of 50 students. The students were a mix of Canadians and Europeans; the Canadian students comprising co-operative education students studying during a work term, on-campus students seeking a flexible option, and part-time students through the Open University. European students received credit for the course through their own institution.

The course was run on a week-by-week basis for a thirteen week term. Students would receive a lecture written in HTML to correspond with assigned text readings, and would see a 'top ten list' of the most important issues to understand for the week. After receiving these materials, the students were required to comment at least once on the material under study. The comment could agree or disagree with the top ten list, bring a personal experience into the discussion, or identify a point from the readings or the lecture notes. A typical week would see at least one student bring in a strong point of view, often from personal experience, and the thread of conversation would follow that thread closely.

Students had access to the professor and teaching assistant in several different ways. They could post a question in the conference, e-mail directly, or have interactive access through virtual office hours.The professor was

available for two hours weekly in an interactive chat room (palace) designed specifically for the University (Brent DeWaal). Questions about the course, exam, and other topical references would typically start the conversation, but the students would often remain signed on after the professor had left to discuss course and social issues together. A separate conference for social issues was set up, but not used by the students in this application of the course. An example of the first two weeks dialogue for the course can be investigated at http://www.sfu.ca/lohnlab/projects/demo/bus362/.

Assignments were sent in via FTP, fax, mail, or e-mail. Problems with this format are that feedback could be unfamiliar to students used to receiving assignments covered with comments on the paper, and that viruses were a frequent concern on the receiving computer. Overall, the students suggested the format was a robust environment in which to learn. The opportunity to take a course while physically away from the campus, and to meet the European students was described as distinctly positive. Performance overall was comparable to a place-based offering, with higher performance on conceptual topics and nearly identical performance on the technique-oriented components of the course.

Enhancing the social nature of Web-based learning .

Cognitive flexibility theory emphasizes the need to organize an array of learning experiences for the novice student. The instructional design principles we use in this course (see Rossner-Merrill, Parker, & Chu, 1998) are implemented in strategic ways to take advantage of the flexibility of the computer-based medium for information sharing and examination of case applications provided by the instructor and through the efforts of the students themselves. We implemented these principles in the following manner:

1. *Present information from multiple perspectives using case studies that present diverse examples.* In the online sessions, *all* students are required to participate in *each* lesson, a practice designed to focus attention on the case-based assignments with examples provided by the instructor and from students' own research and experiences. These are used to support, modify, or disagree with the more abstract concepts under discussion. This approach brings perspectives that are far more diverse by nature of the set expectations for participation and the nature of the dialogue that ensues around key concepts.

2. *Make instruction very specific.* Students move through the course working in a carefully crafted week by week schedule. Weekly topics are outlined in detail, including a topic to focus the discussion and pre-readings from the textbook. To focus this further, the text provides a detailed case running through the chapters outlining the storyboard concept as described above. The students then complete assignments based on a small but integrated case study which parallel the text examples. "Instruction" is far more collaborative in the virtual seminar since the students are responsible for running the sessions during each of the weeks, but the focus remained specific in each format.

3. *Create opportunities for students to develop and articulate their own representations of information.* On-line learning offers distinct opportunities for students to participate which are unavailable in other formats. In a lecture or seminar with fifty students, it can be difficult to draw out personal representations from each, or even a majority of students. There are dominant personalities who see a participative component as an opportunity to get noticed, and there are shy or reserved students who are not comfortable entering into a discussion in such a setting. In an online session, guidelines can be provided for a minimum and a maximum required participative component. Measurement is also easier and more objective. Class leaders in both sessions of the on-line seminar were students who suggested they would not have been so "vocal" in another format. Contrary to some expectations of isolation and lack of interaction, many threads in the week-to-week discussions illustrated personal experiences to emphasize a point and discussed other's experiences in some detail.

4. *Instruction emphasizes students' active knowledge construction rather than the passive transmission of information from instructor to student.* In a place-based setting, several different structures are possible. The lowest common denominator is the lecture format, where a professor dictates information to a student. Current practice includes hands-on sessions, issue and case discussions, and opportunities to break into smaller groups to discuss particular issues. Online seminars move the responsibility for delivery of topical material away from the professor. An online "lecture" can be delivered, but the structure over the week allows for considerably more time for reflection about points made and contribution by each participant at least once. Encouraging personal examples allows for the online session to bring a rich series of illustrations from each participant. The internet also allows participation from diverse geographical boundaries; the students in Europe offered a rich, global

perspective to enter the discussion.

5. *Students are introduced to the complexity of the information to be learned at the outset of the course.* A particular problem for the course is the delineation of the scope and objectives of the material to be covered. Since students come from disparate backgrounds, primarily Information Systems, Accounting, and Computer Science, they bring different expectations and reference points into the class. Much of the material is technique-oriented, which further exacerbates the problem. The solution to this is elusive, and seems more prevalent in the online course than in place-based teaching. Students tend to be unfamiliar with both the material under study and the nature of the online format, so some concerns are nearly always expressed early on in the course. The second offering of the course used a new textbook which outlined the entire scope of the course in an introductory chapter. This helped frame the material under study. Online seminars need to carefully articulate expectations at the outset, but this is a difficult task to accomplish. As the format becomes more familiar, this may become less of an issue.

6. *Stress the interconnectedness of the content to be learned.* A problem with an earlier design of the course was an uneasiness with the goals, leading to questions like 'Where exactly are we trying to go?' As mentioned earlier, a new text adoption with an introductory chapter outlining the total content coverage helped alleviate this problem. This course is offered to students with disparate backgrounds, many of whom have little experience with the material to be covered or its context. An online course covering a topic like this represents a significant challenge. It was found worthwhile to introduce the course material in its entirety very early on in the course to set the context. This deductive approach allows students to reflect back to the "big picture" as the course progresses. The instructor also emphasizes the connected nature of the materials to assist students efforts to conceptualize the many different aspects of the course content.

7. *Avoid oversimplification of content. Look for students' conceptual oversimplification and inability to apply knowledge to new cases.* The Business Administration course includes a combination of broad, conceptual material and technique-oriented topics. The two complement each other, since the techniques represent tools to facilitate the conceptual objectives. A distinct advantage of the place-based offering of the course is the ability of the teacher and teaching assistants to openly discuss methods, and to rapidly create illustrations and examples. This proved difficult in the current design of the online course. Students expressed some frustration or confusion about how to complete assignments, and the technology was pushed to its limit for interaction. Newer conferencing opportunities will mitigate this problem, but it needs to be carefully considered.

Conclusion

We find that online teaching requires a different emphasis than the place-based mode of delivery. Each format can tackle similar objectives, but place-based learning currently has superior interactive opportunities. Online learning, conversely, allows for reflective time in the learning process and a degree of participation well beyond that which is possible within the time constraints of a place-based session. Through the medium of computer-based communication combined with strategic principles of instructional design drawn from constructivist theory, we are able to take full advantage of social aspects of learning in ways that cannot be paralleled in the traditional classroom setting.

Online courses offer students both the flexibility of a Distance Education course and a new, intensive opportunity for socialization and constructive participation. They can bring individuals' worldly experiences into the discussion, and guide the threads that take place in the conferences. There is probably an optimal balance among distance, place-based, and virtual seminars in an educational programme, and an optimal format for particular contexts to be learned. Virtual seminars, we find, have much to offer to this mix, and future research needs to determine the place for each educational setting.

Concluding Vignette: A Student and the Web

Julie, a co-operative education student circa 1994, is a single mother working on a co-operative work term away from her university. She is 18 credit hours away from graduation and hopes to complete her degree in one more semester. To accomplish this, Julie needs to either take six courses in her final semester or find a way to get three credit hours while on her work term.

Study by correspondence

Although not her first choice, she has found a course offered through Distance Education that will fill the three-credit requirement. The flexibility makes completion possible, and her GPA will be a lot better if she keeps the on-campus term to a manageable five courses. After registering, materials are sent to her for self study and she is ready to begin. For Julie, a typical workday is hectic, but manageable, in terms of work and family and study responsibilities. Study time must take place in the evening after the baby is sleeping. Her day is flexible enough to accommodate this but while the opportunities afforded by co-operative education and distance education are engaging, adult conversation is restricted to the workplace.

Study on campus

The following semester, Julie heads back to campus. She quickly revives her friendships with several other students and time on campus has its elements of fun. Several courses are offered in a seminar format where students make presentations and are expected to offer input to the discussion topic. This adds to the experience, and makes the on-campus time considerably more enjoyable than the time spent in the evenings working alone.

Study on the Web

In 1997, Julie is considering a Masters degree as the idea of progressing in her chosen career is luring her back to post-secondary education. A new opportunity has presented itself via a part-time Masters program with a strong distance component supported heavily by the WWW. The web component of the program leads to a Graduate Diploma, and admission to the full-time Masters program would include consideration of work done toward the Graduate Diploma. The flexibility is appealing to Julie, but the thought of more isolated study weighs heavily on her judgement. The idea of trying a new course format with extensive use of computers seems a little intimidating, but she has found one course that looks interesting. She decides to give it a try before committing to either an extended part-time program or another year with reduced and sporadic income.

The course, offered in a novel virtual format, boldly promises strong interactive components, and has a significant portion of the grade allocated for constructive participation. The final note in the outline states that the course is offered simultaneously at both a Canadian and a European university and the idea of meeting and studying "online" with international students intrigues her. Julie registers for the course with rather high expectations, and not just a few concerns about the ability of a computer-mediated environment to be easy to learn, easy to use, and reliable throughout the course.

Julie's application for admission to the course as a post-graduate student without full program registration is approved by the professor, so she registers, pays, buys a textbook, and fights back the feeling of deja-vu this process carries with it. Julie is computer literate, works easily with a browser, and has a full Internet access from her workplace. Daycare can be extended into the early evening one or two nights per week, so she decides to try the course using her office computer right after work. Course virtual office hours run in the morning to accommodate the European time zones (making their office hours in the evening there), and she can arrange to make this time up at work. If this course works out, she intends to buy a computer for home and register with the Diploma Program; if not, at least she hopes to gain a little Internet experience through the course.

Julie and the Web

The instructions included in the course materials identifies a web site to access, an account name and an initial password. The first exercise is to sign onto the site, find the course number, open the introductory lecture, and respond to its instructions. The lecture, written in a rich HyperText Markup Language (html), introduces the professor and the teaching assistant complete with a video clip where they greet students and discuss the objectives and format for the course. The notes then ask students to create a short resume in an on-line forum available only to students in the course, and post a note saying that (s)he is here and properly into the course. (As a joke, the prof states that if you can't access this lecture, please phone.) Julie scans through the resumes of students already in the course, apprehensively clicks the post a message button, then announces her presence. After successfully completing that task, and armed with the information the other students have provided, she starts to work on a short resume describing her current academic situation, her interests, and her reason for taking this course in this particular format. She adds that she is still a little wary of a distance format, but that this seems different.

Course organization and process.

The course starts with an introduction of terms of reference, material to be covered, and a rather lengthy description of the format. Each student needs to download a copy of the chat facility used for virtual office hours every week, and weekly participation is mandatory. For the first few weeks, the lecture material used to start the course is comprised of a lecture written in HTML, with hypertext links to additional material such as the chat software, software available for download to complete exercises and assignments, additional reference materials, or interesting sites. Midweek, the professor posts a top ten list (with apologies to David Letterman) of the most important issues he expects the student to learn. These issues come from the assigned textbook material, the lecture notes, or the postings of students commenting on the week's readings. The students are expected to comment meaningfully on the readings and/or the top ten list, stating whether they agree with it, and to offer other items to include if they feel something was missed. To keep some order in the postings, students are asked to post a maximum of three times per week, and to keep their total weekly postings to a maximum of two screens of text. The participative component of the course is made up of the student's weekly contribution plus a group effort where they are responsible for one of the weekly top ten list. The groups post a list at the beginning of the week starting in the third week, and have an opportunity to revise it after seeing the other student's feedback.

In order to familiarize students with the WWW, the teaching assistant offers prizes for the first student to follow the clues offered in the Internet scavenger hunt. The first hunt is a piece of cake: the TA wants a student to identify the definitive top ten list on the web. Julie quickly finds David Letterman's page, but then notices one of the European students has already won. Julie posts a note begrudging the fact that the European students get a ten-hour head start due to time zone differences, especially since the TA appears to be nocturnal as most of the material is posted late in the evening. Since the top ten needs to be done after the third week by the students working in groups, Julie decides to sign up with one of the European students to get an edge. She can post a message in the evening, and expect a response when she gets up in the morning. This optimizes her chance to do well in the participative component by maximizing the number of times she and her European partner can send messages back and forth. She scans the on-line resumes again, and sends electronic mail to the current scavenger winner congratulating her and asking about her interest in snowboarding. The European student responds that she is coming to the host university on an exchange semester soon, and a friendship starts to form.

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THE EFFECT OF WEB PAGE DESIGN ON STUDENT PERCEPTION OF INFORMATION

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This study examined the use of web page design and how students perceive information based on the amount of graphics on a web page. Students in an introductory education course were asked to rate and rank the importance of information found on three different web sites which utilized various amounts of graphics. Results will be reported at the final presentation of this paper.

Students who use the World Wide Web for research will make judgments and reach conclusions based on information found on web sites. One of the most challenging tasks to teachers who integrate the Internet into the curriculum is to guide students through critical decisions about the validity and reliability of information obtained through web page resources. Under the guidance of an instructor, students may learn to validate Internet information by considering the content and authority of the web page.

One area which should be considered in the critical evaluation of Internet information, but which is not so obvious, is web page design. The layout and use of text, color, graphics, and multimedia may have an influence on how students perceive Internet information.

The purpose of this study was to examine the use of web page design and how students perceive the importance of information obtained from the Internet. More specifically, this paper examined the use of backgrounds and graphics on web pages and their influence on student opinions about the relevancy of content.

This study asked the following question: Do backgrounds and graphics effect student perception of the importance of information on a web page?

Procedures:
Approximately 200 students enrolled in an introductory education course were given an Internet assignment. The purpose of the assignment was to determine the influence of backgrounds and graphics on student perception of the importance of information obtained from web pages. Students were required to visit three web pages, rate the information on each web site, and rank the web sites in order of overall quality. This author (the instructor) was responsible for the content and design and construction of the web pages. Students were given information on each page in question & answer format.

The topics for each page were:
Web Page One - Teacher Certification in Pennsylvania
Web Page Two - The Praxis Tests (National Teacher's Exam)
Web Page Three - The Pennsylvania Common Teaching Application

Three web page designs were used for the study:
No Background with no graphics
Background with one graphic
Background with multiple graphics

Students were randomly assigned to one of three groups based on web page design:

GROUP ONE
Web Page One - No background with no graphics
Web Page Two - Background with one graphic
Web Page Three - Background with multiple graphics

GROUP TWO
Web Page One - Background with multiple graphics
Web Page Two - No background with no graphics
Web Page Three - Background with one graphic

GROUP THREE
Web Page One - Background with one graphic
Web Page Two - Background with multiple graphics
Web Page Three - No background with no graphics

Students were required to visit each of the three web sites and read the information. They were also required to rate each web site on a scale from 1 (poor) to excellent (10) based on the IMPORTANCE of the information and rank all three web sites in order of IMPORTANCE.

The dependent variable for this study was the rating of each of the web sites. The independent variables for this study were the web page design and type of information.

Thus, this experiment involved a 3 x 3 factorial design with three types of web pages designs (no background with no graphics, background with one graphic, background with multiple graphics) and three types of information (Teacher Certification, The Praxis Tests, and The PA Common Teaching Application). An ANOVA will be conducted to determine whether the mean differences between the rankings are statistically significant.

Conclusions will discuss the following questions:
Should web page designers consider the use of backgrounds and graphics in delivering information?
What are the implications for using multimedia and other resources which enhance the cosmetic look of web pages?
What are the considerations involved in teaching students to analyze and evaluate web pages?

This author is the instructor of the introductory education course and is in the process of completing this study. Results will be reported in the final presentation of the paper.

To view the web pages utilized in this study, visit: http://planetx.bloomu.edu/~rpastore/field.html

Session Directories for Setting up and Monitoring CORE2000/Habanero Conferences via Java, CORBA, and LDAP

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Abstract: Pacific Northwest National Laboratory's Environmental Molecular Sciences Laboratory (EMSL) is a collaborative user facility with many unique scientific capabilities. This collaborative facility is supported by an electronic collaborative research environment (CORE2000). CORE2000 is an extension of the National Center for Supercomputing Applications' (NCSA) Habanero environment. (See Virtual Partnerships in Research and Education, WebNet'97.) The EMSL Collaborative team has recently developed a new Web monitoring and session launch facility to CORE2000 that both enhances ease-of-use and provides a means to measure the use of CORE2000 and its component tools over time. The Web Session Directory's (WSD) Java/Swing applet interface displays a list of active sessions, and users, communicating with a Lightweight Directory Access Protocol (LDAP) session database via a Common Object Request Broker Architecture (CORBA) server. In this talk we will describe the approach used in designing this application along with the lessons learned from implementing in these three new technologies.

1. Introduction

CORE2000 is a cross platform electronic collaboration environment that provides audio and video conferencing, whiteboards, shared computer displays, and a growing variety of collaborative data acquisition, analysis, and visualization tools. CORE2000 extends NCSA's Habanero environment and incorporates a number of EMSL and third-party developed tools. CORE2000 is being used by a growing number of people. However, since CORE2000 itself does not include facilities for monitoring and recording usage, we have not been able to quantify this growth beyond measuring the number of downloads of CORE2000 software. We developed the Web Session Directory (WSD) to provide this functionality. WSD displays a list of active CORE2000 sessions and the participants in the sessions. This display provides a sense of community, and with a soon to be added capability to join a session with a simple mouse click, WSD will greatly simplify the setup of CORE2000-based interactions. (Without WSD, the session name, server host name, and server port number must be distributed via phone or email beforehand). WSD also provides a persistent record of past sessions that allows us to track CORE2000 usage. Additional time-stamp information in the record allows calculation of session durations, the pattern of participants joining and leaving a session, and pattern of use of individual tools. This information will be extremely helpful in our efforts to understand the group dynamics of distributed teams and the evolution of these dynamics over time. It will also help us target CORE2000 development efforts.

2. The WSD Architecture

WSD consists of four major components. A Common Object Request Broker Architecture (CORBA) server maintains and distributes information about active CORE2000 sessions. Event logging methods that have been added to the CORE2000 client use the Internet Inter-Orb Protocol (IIOP) to register session, participant, and tool related events with the WSD server. (If errors occur during communication with the WSD server, the events may not be registered, but the CORE2000 session itself is unaffected.) The WSD server persistently stores session information in a Lightweight Directory Access Protocol (LDAP) database. Finally, WSD interfaces, currently implemented as both a Java applet and application, register with a WSD server to receive real-time updates on CORE2000 activity.

The WSD user interface dynamically displays a list of the names of active sessions and the participants in each session. After startup, the displayed list of sessions and participants are continuously updated as new information is received from the WSD server. A user will be able to join a session by clicking a button beside the session's name. This will start the CORE2000 client on the user's machine and pass it the information necessary to connect to the CORE2000 server hosting the desired session. The WSD interface runs on both Unix and PC platforms and uses Java's Swing user interface classes. We anticipate the applet version of the WSD interface, embedded in a dynamic "Status" web page, will be the primary means for CORE2000 users and administrators to monitor activity. The application version may still prove useful, but it was developed originally as a work around for a difficulty we had in getting Netscape's browser to use the CORBA classes in our applet (Iona Technology's OrbixWeb product) instead of the built-in classes from VisiGenics. It is interesting to note the applet is currently much slower in loading than the application (a factor of two even on our internal network), primarily due to the loading of the large Swing library across the network. If the Swing library is put in the browser's local classpath, the applet load time is greatly reduced. (This can be done now by individual users, and will presumably become the default in future browsers.)

The WSD server is implemented in Java using Iona's OrbixWeb CORBA product. CORBA was chosen as a communications mechanism because it provides a natural, object-oriented communications interface, the ability to transparently relocate servers, and the possibility for connecting to software developed in other languages. Currently, the WSD server runs on a Sun Solaris machine, but is capable of running on any OrbixWeb supported platform. The WSD server receives session, member, and tool information from CORE2000 and logs these events to the database as they come in. If CORE2000 is unable to connect with the CORBA server then the connection to CORBA is skipped but users are still capable of running sessions. The CORBA server forwards session and member information to all active WSD user interfaces through the use of client callbacks, an advanced feature of OrbixWeb. During periods of inactivity (configurable), the WSD server can be shut down. When new events occur, the WSD server automatically restarts, loads its state from the database, and responds appropriately.

Netscape's LDAP-based Directory Server is used for the persistent storage of CORE2000 metric information. The Directory Server's schema was extended to include object definitions for sessions, members, and tools. Netscape's LDAP Java Software Development Kit (SDK) was used to provide the connection between the WSD server and the directory. Within the Directory Server, active sessions are maintained within a separate tree to provide quick access for storage and retrieval. Sessions that are no longer active are transferred to a historical tree that is available for analysis.

3. Conclusions

As the use electronic collaboration and conferencing tools grows, the need to monitor and understand the use of these tools grows as well. We have developed such monitoring functionality for the CORE2000 collaboration environment and plan to deploy it to help understand the use of CORE2000 in research and education collaborations involving EMSL staff and their external partners. We expect that this ability to analyze collaborative work habits will be invaluable in developing even more effective collaboration tools. The new technologies used in this project provided significant benefits, but also provided significant integration challenges due to their relative immaturity. Both CORE2000 and WSD are available at http://www.emsl.pnl.gov:2080/docs/collab/ .

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Improving the Design and the International User Interface of Maps on the Internet

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Abstract: The web has become a major form of map distribution with individual web mapping sites reporting over 2 million hits per day (www.mapquest.com). This new medium is helping to promote a highly interactive form of mapping. The interface that supports this type of interaction is in a developmental stage with solutions being developed on an ad hoc basis by individual web sites. These interfaces are often confusing to the user and most are able to determine only a subset of the interactive functions that are associated with an interactive web map. In addition, the control structure may use words in English that make them difficult to use for the non-English speaker. The Multimedia Working Group of the International Cartographic Association has recognized this problem and is working on a set of functionality indicators that may be used to help direct interaction with an interactive map on the Web.

Web-Based Training's Challenges and Solutions

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Abstract: This paper discusses the challenges web-based training presents and what solutions are available. The demand for Internet-Based Training is on the rise. Internet-delivered training can revolutionize training and education at the enterprise level. A paradigm shift in the training industry is occurring from instructor-led training (ILT), manuals, and older forms of media such as videotapes and stand-alone CD-ROMs to Web- or Internet-Based Training. A new set of online learning applications, tools, and architectures needs to be developed and deployed to meet the following challenges. Empower Corporation, a leader in online learning, is providing solutions to those challenges.

Identification and Significance of the Problem

The demand for Internet-Based Training is on the rise. Internet-delivered training can revolutionize training and education at the enterprise level. A paradigm shift in the training industry is occurring from instructor-led training (ILT), manuals, and older forms of media such as videotapes and stand-alone CD-ROMs to Web- or Internet-Based Training. The driving forces behind this paradigm shift include a push from innovations in instructional systems design and technology and a pull from the customer and the market side.

A new set of online learning applications, tools, and architectures needs to be developed and deployed to meet the following challenges. Empower Corporation, a leader in online learning, is providing solutions to those challenges. Empower Corporation is dedicated to providing the best online learning and performance engineering solutions by integrating interactive multimedia technologies and the Internet and intranets with the most innovative and effective instructional design and communication methodologies.

This paper gives an outline of the challenges inherent in web-based training to provide a context to the presentation of Empower's solutions: KaleidoScope and Online Learning Infrastructure (OLI).

Technology Challenges

From CD-ROM/LANs to Intranet and Internet

The inter-networking technology has taken a quantum leap toward offering multimedia information services on a wide area network. Intranets and Internet can not only provide interactive learning content but also support synchronous and asynchronous forms of communication between instructors and students.

From Proprietary to Open Systems

Open architectures, protocols, and data formats are central to this revolution. Online learning architectures and authoring tools should follow the same open systems principles so information sharing and wider access can take place. Traditional authoring tools store data in proprietary formats. Empower Corporation makes use of standard, non-proprietary formats so that all content, information, and applications can share data from a relational database and also so that content is easily reusable.

From Limited and Fixed to Scalable Systems

Interactive multimedia-based content must now be accessible in large volume to larger numbers of users. For that to happen, the content should be housed on a system that can be scalable, both for the number of users and also for the amount and type of content to be accessed.

From Single Platform to Cross-Platform

The World Wide Web technologies such as the browser, HTML, Java, and Web databases allow the content to be developed once and accessed by multiple platforms, which is just one reason the Internet has revolutionized communication technologies.

Online Learning Demands and Challenges

From Large Courses to Learning Objects

More and more learning will take place on the job, just-in-time of need in just-enough chunks. Learning will be customized to the learners' needs, interests, and jobs. Empower's approach allows the learning to be stored in small chunks or 'learning objects' so it can be combined in different ways to personalize the training content. Storing chunked content instead of whole courses in one large, monolithic piece allows for content delivery to be personalized, it allows for much easier searching capabilities, and it also allows for expanded tracking capabilities for the administrator of the courses (the administrator can track what the learner does while in the course—how long he stays on one page, how many times the question was attempted, etc.).

From Individual Learner to Collaborative Learning Organization

Online Learning is shifting from primarily a solitary activity to a collaborative and shared experience that may involve synchronous chats or conferences and asynchronous discussion groups. The implications of this from an instructional—and learning—perspective are great.

From Uniform Instruction to Individualized Instruction

Where every learner used to receive a uniform message or information, in the new model, learning will be individualized to each learner's needs and interests. This is possible only if a networked knowledge database system can manage all the jobs and skills and match them against learning objects or learning modules in customized fashion.

From Learn Once to Continuous Learning

Learning is no longer seen as precursor to a job or a task; it is now seen as fundamental ingredient of the job itself. This premise requires the use of the Web as a means to constantly feed new learning to support the performance of inter-networked knowledge workers.

From Classroom to On-the-Job/Just-in-Time Learning

More and more learning is migrating away from the traditional broadcast-oriented classroom methodology to integration with work and on-the-job. The new system allows for quick, easily accessible "refresher" courses or course modules that can be presented at the learner's desktop. Because learning is broken into chunks served up at the learner's desktop or laptop, and travel and travel-related expenses for training are reduced if not eliminated.

Marketplace Challenges

From High Cost to Low Cost of Delivery of Training

With the widening skills gap, more training needs to be delivered in an immediate and also cost-effective manner. Our approach offers tools to conduct analysis, design, development, learning, and administration of training via the Internet. This reduces the cost of training and collateral expenses.

From Slow to Rapid Rate of Change

The amount of learning and rate of change in content will continue to grow. The World Wide Web is the logical choice for distributing training content. Our approach offers Java- and ActiveX-based tools and templates to expedite the training content development process.

From Local Access to Distributed Access

Organizations are demanding the learning content to be made available at an enterprise level. Empower's approach can be used to offer training content via Internet or Intranets.

From Single User to a Community of Users

Online learning must evolve to encompass a variety of roles within an enterprise. These include instructional analysts and designers, subject matter experts, media developers, programmers and authors, learners, administrators, instructors, etc. Empower's approach offers tools for different roles in the training function.

From Independent to Interoperable Learning Content

The learning content is in total disarray due to lack of standardization in which content is created. As more and more corporations deploy Intranets, learning content from different vendors would need to co-exist and interoperate so it can be administered and delivered in a consistent manner. Empower uses IMS-compliant, non-proprietary, open standards for its solutions.

From Pay Once to Pay Per Use

Billing will evolve from pay once for a content that does not change to pay per on-demand content. Empower's tools allow training administrators to meter the usage of the learning content.

Empower Corporation's Solutions

Empower Corporation is currently developing open, scalable, and standards-based tools and architecture that address the issues and rectify the problems detailed in the above section.

KaleidoScope: A System for Developing and Managing Learning Objects on the Internet/Intranet

KaleidoScope, a performance management system, provides collaborative tools for the systematic analysis, design, development, evaluation, and distribution of learning objects over the Internet or an Intranet. These tools are based on time-tested human performance methodologies that emphasize both macro- and micro-level instructional design principles. KaleidoScope offers a flexible step-by-step approach to designers and developers in creating instructionally sound learning objects. An Electronic Performance Support System embedded in KaleidoScope provides explanations and guidance on all aspects of the design and development process.

Online Learning Infrastructure (OLI)

On-line Learning Infrastructure (OLI) is an enterprise-wide courseware design, development, and distribution infrastructure for Intranets or the Internet. Based on a multi-user client/server architecture, OLI capitalizes on industry-wide open standards such as relational databases and Java/ActiveX to provide a scalable, cross-platform solution. Launchable from a Web browser, OLI's plug-and-play applets are designed for use by content designers, administrators, and students.

See http://www.empower-co.com for further information about Empower and its products.

A Tool For Homework Submission Using the World Wide Web

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Introduction

We present here the design and implementation of a web-based homework submission system. The advantages of this system are simplicity, robustness and convenience. Students have the same interface independent of the computer/operating system from which they submit their work. The system is easy to use, and gives the student clear error messages and positive feedback on successful submissions. The instructor interface is also convenient to use and simplifies management and preparation of files for grading. The main disadvantage of this system is that if the web server is down or if there are network problems, submissions cannot occur. This system is designed for handling homework submission, not grading, analyzing or checking for similarities. Others [Dawson-Howe 1996][Leach 1995][Wise 1992] have proposed mechanisms for handling these issues, and their ideas can generally be used in tandem with this system. Requests for copies of the software should be directed to the second author.

Specifications for the System

In addition to the general requirements of ease of use, robustness, consistency and security, there were several specific requirements to be considered. The system needed to be flexible enough that many (most) of the instructors in the department would use it. Uniformity of the homework submission process in the department reduces confusion in students. We also wanted to minimize the time and effort an instructor would have to spend in setting up the class submissions and in "collecting" the assignments once they were turned in. We did not want to require that students have accounts on the submission system itself. Consequently, it becomes convenient to "clean up" at the end of a semester or quarter and to prepare for the next one. Also, the submit system can run on a quite modest machine. However, this implies that the submit system must itself handle authentication of its users. The student interface had two additional requirements: it should be designed so that the amount of typing required is minimized (thus fewer mistakes are made), and clear feedback should be given to the student when she/he attempts a submission.

Student Interface

The student can perform two tasks from the student submit web page---submitting homework files, and changing their submit password. For both options, the student must enter their submit username and password. For submitting homework the student should select her class/section. A drop-down list of all classes using the submit system is available for entering the class. This input method averts many typographical errors by the student. If the student is authenticated, he or she is presented with a submission page. From this page, the student can use the drop-down list to obtain the "names" of assignments given so far in the class (for example, "CashRegisterProgram", "BinarySearchTree", "Shellsort"). Once an assignment is selected, the student can simply indicate the file or files to submit for that class and assignment by clicking on the Browse button (which corresponds to the file upload facility in HTML forms). Once a file is selected, it appears in the list of files to be submitted. Multiple files can be submitted for a single class and assignment (for example, a C program, two header files, and a data file). Once all files to be submitted have been added, the Finish Submission button completes the process. The student will either be presented with a successful submission message or an error message indicating that there was a problem. All error messages are clear and give recommendations on how to proceed. The student has the option to cancel the submission at any point.

Instructor Interface

There are seven different tasks that the instructor (or teaching assistant) can perform from the instructor page. These are: create/modify the class list, create a new assignment, collect an assignment, show submissions so far for an assignment, delete old assignment files, disallow future submissions for an assignment, and change password. Each of these takes appropriate parameters and the system indicates whether the task succeeded.

Administrator Interface

The submit administrator has the responsibility of installing the submit system and setting up instructor access and class initializations. The administrator has two basic options: adding a new instructor/T.A. to the system, and setting up access for a class. An instructor password file contains information about instructors and teaching assistants. Creation and modification of the instructor password file is performed by the administrator. Before a class can use the submit system, the submit administrator must enable access to it. For security reasons, we chose not to provide web access to the administrator's functions. A menu driven text interface is used instead.

Behind the Scenes

The submit system was written using only HTML [Musciano and Kennedy 1997], JavaScript [Vander Veer 1997] and Common Gateway Interface (CGI) [Gundavaram 1996] scripts. Since these CGI scripts are for the Bourne shell, the submit server must be some variant of Unix. Specifically, we have tested the system on Sun Microsystems' Solaris 2.5 and Silicon Graphics' IRIX 5.3 operating systems. Since one part of the submit system uses the crypt encryption command, it is necessary to use the US releases of these operating systems.

The submit system uses a hierarchical directory structure to store submissions. At the topmost level are the individual class directories (such as cs101-01, cs433-02 etc.) Each such class directory contains one subdirectory for each assignment created by the instructor. Under each assignment directory is a subdirectory for each student of the class. When student S makes a submission for class C, assignment A, at time T, a directory /C/A/S/T is created under the root of the submit hierarchy and the submitted files are placed in that directory with their original names. Collection of an assignment causes a */collect* subdirectory to be created in the assignment directory. Symbolic links are placed in the collect directory to the most recent submission directory of each student, for the indicated assignment. When an assignment is collected, the instructor is given the option to create a zip archive of the assignment subtree. This allows the assignment to be easily moved to another machine or copied onto a diskette.

Software Requirements

We use a Netscape Commerce server as the back-end of our submit system for its wide availability on Unix systems and the availability of secure communication. We require the use of the Netscape Navigator browser (version 3 or better) as the client since the front-end depends heavily on JavaScript for proper functioning.

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Tools for Authoring and Presenting Structured Teaching Material in the WWW

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Abstract: This paper presents aspects of modeling, authoring and presenting structured documents corresponding to teaching material presented in the World Wide Web. In this context, it is discussed the importance of providing the formalization of the structure of the documents using SGML. Next, specifications for structured documents corresponding to didactic texts and questionnaires are presented. Software tools to the authoring and presentation of those documents are then discussed. The paper concludes with a discussion on related work and next steps of this research.

1. INTRODUCTION

The increasing interest in providing teaching material available in the WWW has lead to the development of many HTML documents by teachers and authors of teaching material. Because most tools for generating such documents were built with a generic document model in mind, authors have little support to implement any necessary structure. Important work has been done in terms of providing support to the authoring process of teaching material by casual novice users, a case in point is the Web Course Tools (WebCT) developed at University of British Columbia [WebCT 1997].

Another issue in this area is related to static nature of HTML documents: every student is exposed to the same information, regardless of their experience or background. In order to provide customized content information to students, Brusilovsky et al. presents a tools for generating adaptative hyperbooks from annotated RTF (rich text format) documents [Brusilovsky et al. 1996]. As the WebCT case, however, the format of the documents is proprietary such that only their tools are able to built and explore the document structure and control the presentation. As far as the provision for the interchange of documents containing teaching material is concerned, Tinoco et al. report work on modeling quizzes using SGML (Standard Generalized Markup Language) [ISO 1986]. This means that the documents containing a quiz is marked so as to conform with a

formally defined structure, and as such can be used by any software tool able to process the SGML markup. In their work, quizzes are stored in a server so that they can be accessed and solved by students: the answers are sent back to the server and processed, the achieved score being stored for further processing [Tinoco et al. 1996]. In this context, this paper presents a set tools supporting the authoring of teaching material structured using SGML, as well as the presentation of the material in the WWW. Next section the modeling of the domain using a well-known method from the hypermedia literature. Using simplified SGML notation. Section 3 formalizes the structure of documents corresponding to generic teaching material and questionnaires, whereas Section 4 presents tools for authoring and presenting the corresponding documents. Section 5 presents final remarks and future work.

2. A MODEL FOR THE EDUCATIONAL DOMAIN

The Relationship Management Methodology (RMM) was used to define the initial model for the domain where the teaching tools and associated material is to be applied. The methodology has been built to be used in domains where classes of objects have relationships among them, and where multiple instances of objects are related to each class. As it has already been demonstrated by the proponents of the methodology, the educational domain meets both requirements [Isakowitz et al. 1995].

The model presented in the Figure 1 is generic so as to be applied to many educational domains, and is in accordance, for instance, to the Hypermedia-Based Learning Environment [Nykäne and Ala-Rantala 1997] and Framework for Hyperbook Design [Fröhlich and Nejdl 1997].

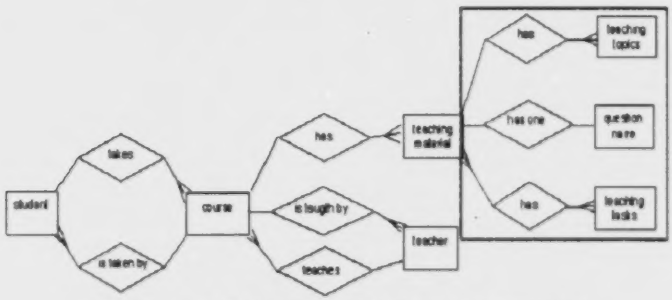

Figure 1 - E-R diagram for the target environment

The work reported here took a different approach: instead of providing a graphical slice diagram for each entity to be presented to the user, a SGML-based DTD was built. In the DTD, both the information contained within the entity and the relationships with other entities defined in the E-R diagram are specified. This is also an advantage over less formal directions as those presented by Bevirt [Bevirt 1996]. As a result of this approach, DTDs for the entities teaching material, class topics, questionnaire where built; two of them are detailed in the next section.

3. STRUCTURED TEACHING MATERIAL AND QUESTIONNAIRE

The SGML standard was proposed to allow the formalization of the structure of documents stored in an electronic medium. SGML demands that definition of the document structure be performed independently of the presentation form of the document. The advantage of using such a standard is that the documents, stored in some electronic medium, can be processed by any compliant environment, whether it is related to authoring, storage or presentation of such documents. A DTD defines a class of documents establishing definitions for elements, attributes and entities. Three DTDs were defined in the context of the educational domain presented in the previous section: a DTD for teaching material, Teaching Material Markup Language - TMML; a DTD for questionnaires, Questionnaire Markup Language - QuestML; and a DTD for teaching tasks, Teaching Tasks Markup Language – TTML.

3.1. THE TEACHING MATERIAL MARKUP LANGUAGE - TMML

Figure 2 presents a simplified version of a DTD for teaching material, the TTML. A TTML document has elements in three levels, corresponding to the elements head, body and tail.

```
<! Simplified DTD for Teaching Material  TTML -- >
<! Elements mincontent -- >
<!ELEMENT TTML - - (HEAD, BODY, TAIL) >
<!ELEMENT HEAD - - (TITLE, SUBJECT, LEVEL, AUDIENCE,
 ABSTRACT, AUTHOR) >
<!ELEMENT BODY - - (ITEM)+ >
<!ELEMENT TAIL - - (TASK*, QUESTIONNAIRE) >
<!ELEMENT TITLE - O (#PCDATA) >
<!ELEMENT SUBJECT - O (#PCDATA) >
<!ELEMENT LEVEL - O (#PCDATA) >
<!ELEMENT AUDIENCE - O (#PCDATA) >
<!ELEMENT ABSTRACT - O (#PCDATA) >
<!ELEMENT AUTHOR - O (#PCDATA) >
<!ELEMENT ITEM - - (TITEM,SUBITEM)* >
<!ELEMENT TITEM - - (#PCDATA) >
<!ELEMENT SUBITEM - - (#PCDATA|(TSUBITEM,P)*) >
<!ELEMENT TSUBITEM - - (#PCDATA) >
<!ELEMENT P - - (#PCDATA)* >
<!ELEMENT TASK - - (#PCDATA) >
<!ELEMENT QUESTIONNAIRE - - (#PCDATA) >
<!-- element name attribute name value default -->
<!ATTLIST TTML STATUS (OK,DRAFT) DRAFT
ID ID #IMPLIED >
<!ATTLIST ITEM ID ID #IMPLIED
IDREF IDREF #CONREF >
<!ATTLIST SUBITEM ID ID #IMPLIED
REFID IDREF #CONREF >
```

Figure 2 - Simplified DTD for Teaching Material: TTML

A head element contains a set of mandatory elements: title, subject, author, level, target audience, abstract and author. The body element is composed by any number of nested items and sub-items elements, each one having its own title part. The tail element allows the specification of a list of optional tasks, followed by a mandatory specification of the associated questionnaire.

3.2. THE QUESTIONNAIRE MARKUP LANGUAGE - QuestML

Figure 3 presents a simplified version of a DTD for a questionnaire, the QuestML. Similarly to TTML, a QuestML document has elements in three levels: head, body and tail. A head element has all the elements of the TTML head but the abstract element; an optional comment element is allowed instead. The body element is composed by any number of nested questions. Three types of questions are defined: truefalse, choice and open.

```
<!-- Simplified DTD for Questionnaire  QuestML -->
<!-- elements mincontent -->
<! ELEMENT QUESTML - - (HEAD, BODY, TAIL) >
<!ELEMENT HEAD - - (TITLE, SUBJECT, LEVEL, AUDIENCE, COMMENT?, AUTHOR) >
<!ELEMENT BODY - - (QUESTION)+ >
<!ELEMENT TAIL - - (SUBMIT?) >
<!ELEMENT TITLE - O (#PCDATA) >
<!ELEMENT SUBJECT - O (#PCDATA) >
<!ELEMENT LEVEL - O (#PCDATA) >
<!ELEMENT AUDIENCE - O (#PCDATA) >
<!ELEMENT COMMENT - O (#PCDATA) >
<!ELEMENT AUTHOR - O (#PCDATA) >
<!ELEMENT QUESTION - - (TRUEFALSE | CHOICE | OPEN) >
<!ELEMENT TRUEFALSE - - (OPTION) >
<!ELEMENT CHOICE - - (TEST, OPTION+) >
<!ELEMENT OPEN - - (TEST, NOPTION) >
<!ELEMENT TEST - O (#PCDATA) >
<!ELEMENT OPTION OO (WHAT,WHY? WHERE?) >
<!ELEMENT NOPTION OO (WHY,WHERE?) >
<!ELEMENT WHAT - O (#PCDATA) >
<!ELEMENT WHY - O (#PCDATA) >
<!ELEMENT WHERE - O EMPTY >
<!ELEMENT SUBMIT - - EMPTY >
<!-- element name value default -->
<!ATTLIST QUESTML STATUS (OK | draft) draft
ID ID #IMPLIED >
<!ATTLIST QUESTION ID ID #IMPLIED
IDREF IDREF #CONREF >
<!ATTLIST TRUEFALSE KEY (true | false) true >
<!ATTLIST CHOICE KEY NUMBERS #REQUIRED
MULTI (true | false ) false >
<!ATTLIST OPEN WHO CDATA #CURRENT >
<!ATTLIST WHERE IDREF IDREF #CONREF >
```

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Figure 3 - Simplified DTD for Questionnaire: QuestML

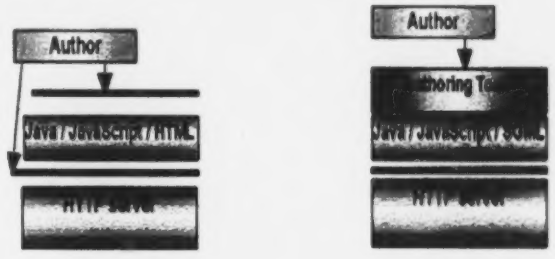
The body element is composed by any number of nested questions. Three types of questions are defined: truefalse, choice and open. A truefalse question has a single option element, which corresponds to the concept a student has to agree or disagree with. A choice question has a test part and an option part. The test correspond to what concept is being evaluated, and the options part correspond to a set of concepts the user can select. Each option is composed of a what element (the question itself) and optional why and where elements. The why element is supposed to state why the select option is or not correct, whereas the where element can indicate, via a hypertext link, a point where that particular subject is discussed. A open question has a test part and a noption part. The noption element is equivalent to the option element without the what part, since that the user is supposed to freely reply to the question proposed by the test part.

After the presentation of the DTDs, the next section discusses aspects of using such structures from the point of view of tools for authoring and presenting the related information.

4. AUTHORING AND PRESENTING TTML AND QUESTML DOCUMENTS IN THE WWW

The aim of the work here reported is not only to facilitate the creation of the structures documents, but also to allow them to be presented in the WWW. Moreover, for the QuestML documents, a user (student) should be allowed to answer the questions while using a WWW browser and receive the associated score.

Figure 4a presents a general architecture of the components used in the WWW to present interactive documents. In further, the general approach adopted in this work was to build tools that would help the authoring of the structure of the documents in order that they could, then, be extended with HTML contents using and presented in the WWW. This is illustrated in Figure 4b, where a new level corresponding to the tools isolates the author from the details of authoring and publishing.



(a) (b)

Figure 4– (a) General architecture of the components used in the WWW. The arrows represent the Interfaces between an author and the languages used in the WWW. (b) Architecture extended with tools that allow the authoring, publishing and presenting of SGML-based documents extended with Java and Javascript.

In this context, a set of tools was implemented at support the authoring both teaching material and questionnaires.

4.1. AUTHORING AND PRESENTING STRUCTURED TEACHING MATERIAL

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HyperBuilder is a tool that guides the authoring of the elements corresponding to the TTML DTD. The approach is to present to the author the several elements allowed in the document; as the author completes the contents for those elements, a document reflecting the TTML structure is built.

HyperBuilder, illustrated in Figure 5a, allows an author to include the elements the document, according to the structure defined in the TTML DTD. First-level elements, such as title and abstract, have their contents inserted in the main document, while items and subitems are associated to new files corresponding to lower levels in the hierarchy of the document. At any time, HTML existing contents can be imported to any of the documents in the hierarchy. When a file is saved, the main TTML document is saved along with a set of HTML related files. The author has an option to presenting the hierarchy using frames or and an index embedded in the main document. Another option allows the HTML files to be published in a WWW server, from where they can accessed from any web browser, as shown in Figure 5b.

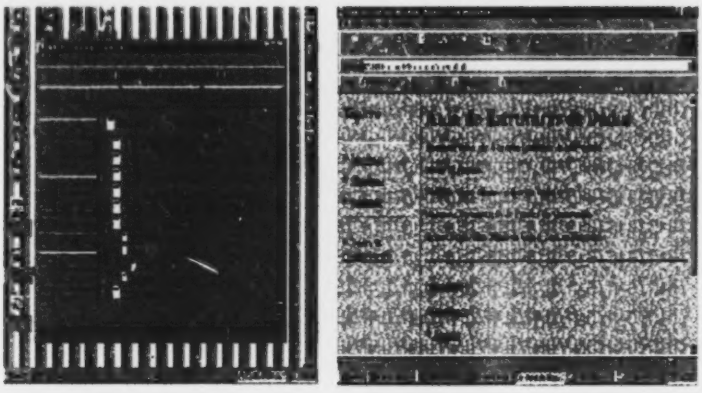

Figure 5: (a) HyperBuilder interface. (b) A TTML-based document presented in the WWW

4.2. AUTHORING, PRESENTING AND EVALUATING STRUCTURED QUESTIONNAIRES

Figure 6a illustrates the use of the QuestBuilder tool, which allows the authoring of a QuestML document. Similarly to TTML documents, QuestML questionnaire can also be published directly a the WWW server. Because a questionnaire is one of the elements of a TTML document, a user accesses a questionnaire when the link test is activated in the corresponding TTML document (Figure 6b).

The fact that the Java language allows fine interaction and computation in the browser has been exploited in this tool. Since the correct answer is part of the content of test-based questions, these can be automatically evaluated when a student finishes a questionnaire. The answers are only shown when a minimum score is achieved, as specified by the MIN element. When open questions are used, the answer is mailed to the person specified by the element WHO in the question. The element SUBMIT will be used when the tools are integrated within the database, in order to keep track of the evolution of the student.

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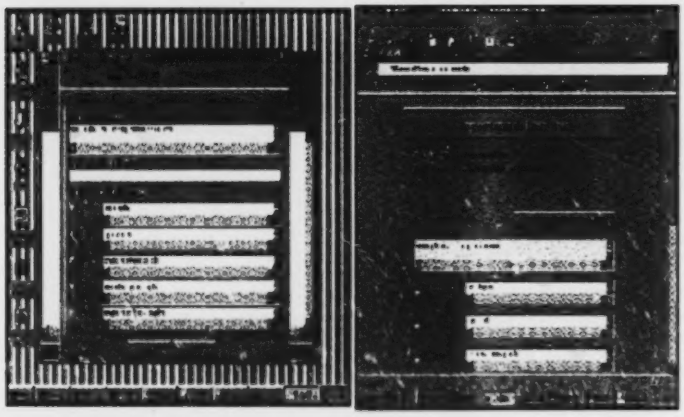

Figure 6: (a) QuestBuilder interface. (b) A QuestML-based document presented in the WWW

5. FINAL REMARKS

Gaines remarks that the growth of the Internet and the WWW, and the evolution of their underlying technologies, may contribute to the foundations of the knowledge science [Gaines 1996]: there is no doubt that exploiting such an environment in the educational domain may bring many contributions. Important work has been done in terms of providing environments where teachers and students can interact, produce and navigate through course-related documents.

This paper has presented undergoing work aimed at building an environment that supports teaching and learning activities in the WWW. The highest level of the entities and their relationship have been presented. An important step was taken in terms of creating document type definitions (DTDs) from the entities and relationships identified. Such mapping, which has guided both the construction of the related authoring tools and defined presentation and navigation structures, has not yet been reported in the literature.

Specifications for structured documents containing teaching material and questionnaire have been discussed, tools associated to the authoring of those documents presented, and the approaches for presenting the documents indicated. At the time of this writing, the environment that will integrate the documents stored in the WWW server with the remaining information related to the courses (Figure 1) is under construction.

The work reported has advantages over other reported in the literature because: (a) the documents supported are structured according to a standardized language; (b) the clients and servers are freeware and platform independent; (c) the tools for authoring and presentation built are also platform independent since Java has been used in all implementations.

The next steps of this work include (a) concluding the tools allowing the storage and retrieval of the documents and other related information from a database; (b) experimenting the tools with novice and casual teachers and students; (c) exploring alternative linking structure within the hyperdocuments, as proposed in [Pimentel and Bufford 1996]; and (d) further investigating the integration of a DTD construction phase in hypermedia design models.

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Strong Cryptography With Exportable Browsers

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Abstract: This paper demonstrates a way to let users of exportable browsers transmit data over a highly secured SSL connection over the internet. The solution is based on an Java Applet which reopens a connection back to the server where it was loaded from. Further this paper discusses problems related to firewalls which don't allow an Applet to connect directly to another host outside the LAN. Using a demo Applet, some restrictions of SSL connections opened in that way are shown. In addition, problems concerning the different JDK implementations found in common web browsers and a technology called Java Activator are analyzed with respect to our example.

1. Introduction

The two browsers most commonly used to navigate through the Internet are Microsoft's Internet Explorer and Navigator from Netscape. To provide the users with the possibility to also transmit confidential information, the two browsers make use of the Secure Sockets Layer (SSL) protocol developed by Netscape. Because of the U.S. export restriction for strong cryptography, the exportable versions of these two browsers can only use 40 bit encryption - thus making the security features useless for users outside of the U.S.

On the other side many companies offer their customers special services where sensible data, like credit card numbers, product orders or statements of their account have to be transmitted over the internet. This paper shows a solution of this problem through the usage of Java-Applets (http://www.javasoft.com/applets/index.html). A signed Applet is loaded from the web server and started in the browser. Now this Applet opens a strong encrypted SSL connection back to server hence enabling the user to transmit his sensitive data over a highly secured connection. Another advantage of this approach is, that the company can provide the user with a GUI based user friendly program instead of simple HTML forms.

2. Web Browsers And Java Applets

Since versions 3.0, Navigator as well as Internet Explorer support HTML pages with embedded Java Applets. An Applet is a small, platform independent piece of software, which is loaded from a web server like a picture and executed within the browser of a user. To prevent an Applet from damaging critical data or spying sensitive information, an Applet has nearly no privileges on the computer on which it is executed. For example an Applet has no access to the local file system or to the system properties and is also not allowed to open a connection to another host, except to the one it was loaded from (Applet Security FAQ: http://java.sun.com/sfaq/).

2.1 Usage

To specify an Applet embedded into a web page a special HTML tag has to be used:

```
<applet codebase=/applets/
        archive=demo.jar
        code=Test.class
        width=460
        height=160>
<param name=prop value=val>
</applet>
```

This tag causes the browser to load the specified Applet and run it on the local machine. The fields specify the details:

- the Applet and all additional required classes are located in the Java Archive *demo.jar*
- the archive can be found under the relative URL /applets/demo.jar on the server
- the class `Test` must be executed after loading
- and a display window with the size 460x160 has to be used
-

It is also possible to specify several name – value assignments within the HTML page. This example for instance defines the property *prop* and sets its value to *val*.

The given archive contains all classes needed to execute the Applet in one compressed file. To ensure the integrity and authenticity of a JAR file, digital signatures can be used (since JDK 1.1). The browser verifies the signature after downloading the jar file and only executes the Applet if the signature is ok and the certificate of the signer has been found it the database of trusted signers.

2.2 Different Versions Of The JDK

One problem when dealing with Java Applets is the fact, that the various browsers implement different versions of the Java Development Kit (http://www.javasoft.com/products/jdk/) more or less completely. At this time, different browsers are still being used widely, that support four major versions of the JDK, which show the following characteristics in concern to our needs:

2.2.1 JDK 1.0.2

This was the first version of the JDK which was mainly developed for enhancing web pages with the help of Java Applets. JDK 1.0.2 provides an Applet developer with some basic classes for elementary usage. The main advantage of JDK 1.0.2 is the fact, that every Java enhanced browser fully supports this version.

One primary drawback of JDK 1.0.2 is the lack of some essential classes and packages which are needed for developing secure applications (e.g. *java.math.BigInteger* or *java.security.**).

2.2.2 JDK 1.1.x

The second generation of the JDK introduced some basic security features, such as signatures, certificates, key pairs, message digests, etc. and a class for dealing with arbitrary-precision integers, which are of great interest for our purposes. Unfortunately Internet Explorer 4.x is the only current available browser which completely supports the new security classes.

It is true that Netscape claims to support JDK 1.1, but in their implementation all classes from the java.security package are missing. In addition it is impossible to dynamically download and install theses classes from a web server too, because Navigator does not allow to load system classes (all classes in packages starting with *java.**) over the web.

Unfortunately the only solution to this problems is to re-implement the missing classes required for our application.

2.2.3 JDK 1.2

This is the newest version of the JDK. At this time only a beta version exits and the final version is planed for this summer. Because it is not clear if any browsers will actually support this new version, JDK 1.2 will not be taken in consideration for the rest of this paper.

2.2.4 Java Activator

To solve the problems with poor Java implementations in web browsers Sun, the inventor of the Java programming language, introduced a new technology called Java Activator (http://www.javasoft.com/products/activator/index.html). Java Activator uses ActiveX in the case of Internet Explorer and Plug-In's in the case of Navigator to activate their own implementation of a full JDK 1.1 compatible Java Virtual Machine (JVM) whenever an Applet is loaded over the web. Although this is a very clever solution, there are still some major problems:

- All HTML pages must be changed, because the standard Applet tag solution would invoke the browser's original JVM. Instead of the Applet tag a Java Script has to be used, which is executed by the browser. This script determines, if it shall launch a compatible JVM (e.g. Suns HotJava), the ActiveX - JVM or the Plug-In - JVM.
- A user has to download and install a file, which is several megabytes big.
- A user has to manage the certificates for dealing with signed Applets twice: for his favorite browser and for the Java Activator.

Another problem common to all JDK versions is the fact that an Applet has no access to the local file system. This in consideration of security issues necessary restriction prevents an Applet from storing configuration information or loading a certificate and its corresponding private key for client authentication.

Due to several problems with the browsers implementations of the JVM as well as with the Java Activator approach, the only way to ensure that an Applet works in almost all popular browsers used today is to base the implementation on the JDK 1.0.2. The lack of some required classes cause no big problem since for Navigator the missing classes have to be re-implemented, too.

2.3 The Firewall Problem

If a local area network (LAN) is protected through a firewall system, a computer within that network is not allowed to open a direct connection to a machine outside the scope of the firewall. To use browsers in such an environment, one only has to configure the browser to connect over a proxy when communicating with foreign hosts.

For Applets, a firewall causes a very big problem. As the Applet has no means to access configuration information, there is no way for the Applet to find out the name of the proxy host which must be used to connect to a host outside the LAN. Therefore an Applet cannot open a new SSL socket connection to the host where it was loaded from.

However, there is another possibility to open a connection to this host. The class *java.net.URL* from the JDK 1.0.2 offers another technique to open a connection to an URL located at the web server. If this method is used, the browser opens a connection over the proxy to the specified resource and provides the Applet with an output and an input stream. All further communication can now take place over this established connection.

The resource accessed in that way must be an active component (CGI script, Java Servlet, web server extension, etc.) which builds the endpoint of this embedded SSL connection. Any data received must first be decrypted and then passed to the module which performs the required operations. Another way is to use a special, for this purpose adapted SSL proxy server which also decrypts the received data and forwards it to a specified URL. The advantage of this second solution is the possibility to use any kind of SSL server (not only a HTTP server) to securely communicate with.

3. SSL

The SSL (Secure Socket Layer) Handshake Protocol (http://home.netscape.com/eng/ssl3/index.html) was developed by Netscape Communications Corporation to provide security and privacy over the Internet. The protocol supports both server and client authentication. The SSL protocol maintains the security and integrity of the transmission channel by using encryption, authentication and message authentication codes (MAC).

The SSL Handshake Protocol consists of two phases, server authentication and key exchange with an optional client authentication. In the first phase after receiving a client hello message the server sends its certificate and agrees with the client on a common cipher suite which consists of a combination of

- a key exchange algorithm (Diffie Hellman, RSA)
- a symmetric cipher (RC2, RC4, IDEA, DES and triple-DES)
- and a hash algorithm for the MAC (MD5, SHA)

In the second phase a shared secret (also called master secret) is exchanged according to the key exchange algorithm specified in the first phase. If the server requested client authentication the client sends its certificate and a signed piece of data to prove that it is also the owner of the private key. Subsequent data is

encrypted with keys derived from this master secret. To avoid reputation attacks, a close notify alert message is sent to indicate the termination of the connection.

4. The IAIK Solution

IAIK developed a package for establishing high secure connections from an Applet back to the server it was loaded from by using the SSL version 3.0 protocol. Because only those minimal properties of SSL useful for an Applet are implemented, the size of the jar file containing the whole package is less than 40 Kbytes which ensures minimal loading times.

The core of the package builds the class *SSLConnection*, which allows to setup secure connections either directly to the host through a socket, or over an URL connection provided by the browser.

4.1 Direct Connection Over A Socket

If the browser runs on a computer which is located in an LAN not protected through a firewall, the Applet is able to open a direct connection to the SSL server. From the servers point of view this is an ordinary SSL connection, using strong encryption, as it would be the case if an U.S. domestic version of browser was used. The advantage of this solution is the fact that no additional processing has to be done for an Applet-SSL connection on the server side.

The only requirement for this kind of application is that the SSL server also must support strong SSL encryption.

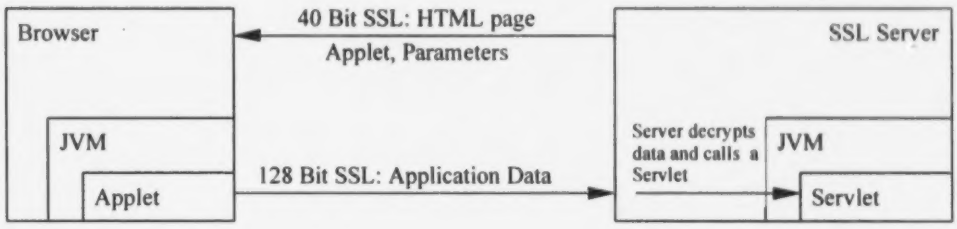

Figure 1: Direct Socket connection

4.2 URL Connection Over The Browser

As already described in section 3.3 there is no way for an Applet to discover the name and the port of a possibly existing firewall which does not allow hosts to open direct connections to other hosts on the internet.

Through the usage of the URL class implemented from the browser the correct way for opening connections over the firewall will be applied. Using this approach it is further feasible to encrypt the connection to the SSL server twice. First the application data is encrypted through the SSLConnection and then the encrypted data is sent over the weak 40 bit SSL connection provided by the browser.

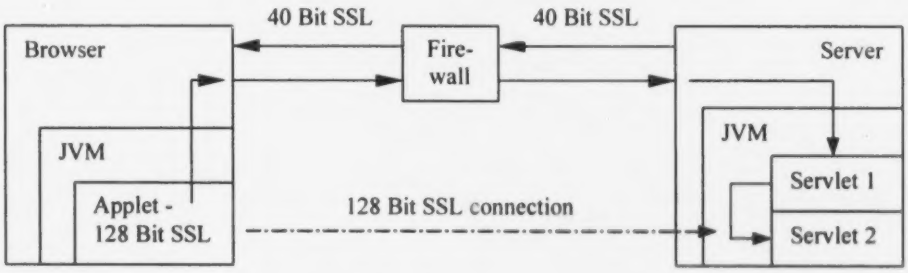

Figure 2: Connection over an URL

On the server side this solution means additional computation: The active component specified through the URL has to act as the endpoint of the SSL connection and therefore decrypt the data and pass it to the second Servlet as with a direct socket connection which performs the required actions.

4.3 Security Of The SSL Connection

The only problem relating to the security of this solution is that the user downloads another Applet from a server which claims to be the requested server (Man in the Middle Attack). This uncertainty can be eliminated by only allowing to download the Applet over the 40 bit SSL connection. When the browser opens the connection for the first time the server authenticates itself by sending its certificate to the browser. If the server certificate is trusted everything is ok and the procedure continues. But if the browser does not trust the server certificate it will show an alert box and the user may cancel the connection.

After the Applet from the authenticated server has been loaded and initialized, a number of secure random bytes are generated. This could be managed by tracing the movement of the mouse or recording other events caused through some user interaction. Now the user can enter a username – password combination or a PIN to authenticate himself to the server. After that the Applet opens a connection to the server and verifies the data. If everything is alright the user can start to use the service provided through the Applet.

After the user has finished his work he presses the logout button to close the connection. It is also possible to open a new connection for every piece of data which is transmitted to the server. In that case the server has to maintain a session which will be terminated when the user presses the logout button.

4.4 Restrictions Of The Applet-SSL Connection

Due to the fact that this SSL connection is built from an Applet executed in a browser, some SSL features are unnecessary and therefore not implemented:

- The certificate presented by the SSL server is ignored and instead of it the public key of the server is hard-coded into the Applet source. This restriction does not limit the general applicability of this solution, because an Applet can only connect to one server in any case, the one where it was loaded from. If an Applet have to run on several machines, it only needs to be recompiled with the correct public key set. The benefit of this simplification is, that one saves the whole ASN.1 implementation which would be needed to parse X.509 certificates thus enormously reducing the size of the Applet.
- The ServerKeyExchange message can also be ignored because the public key is hard-coded in the program. The SSL handshake message ServerKeyExchange is only sent if the public key from the server certificate cannot be used for key exchanging.
- Client authentication cannot be used, since an Applet has no access to the local file system (especially in JDK 1.0.2) from where a certificate and a private key could be read. To authenticate the user to the server, some kind of PIN code can be used. This restriction does not affect the security of the system because every data transmission is performed over a strong SSL connection.
- The session caching mechanism of SSL version 3.0 can be simplified through the fact that only connections to one specific host are possible.

4.5 Features

The current implementation of the SSL connections shows the following features:

- 128 bit IDEA, 64 bit DES or 168 bit triple-DES as symmetric cipher
- RSA or Diffie-Hellman for exchanging the master secret (keys)
- Session caching for faster further connections to the server
- MD5 or SHA as internal hash algorithm for the MAC
- A jar file with less than 40 Kbytes including all necessary classes
- Works on every Java enabled browser

5. Conclusion

The usage of SSL connections within Applets lets companies elegantly resolve the low security problem of exportable browsers and therefore offering secure services over the internet. It is true that there are some restrictions in comparison to ordinary SSL connections, especially client authentication is not available. But as there are other authentication schemes like username and password or PIN codes this restriction should cause no problems.

If browsers in near future completely support JDK1.2 nearly all restrictions can be dropped. For example it would be possible for Applets signed from a specific entity to access a certificate and the corresponding private key stored in file to enable client authentication.

The role of static and dynamic shadows in a three-dimensional computer environment

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Abstract : The aim of this study was to analyse the effects of manipulating the contextual cues of depth on the accuracy of an aiming task in three-dimensional computer environment. Subjects performed a pointing task. For this task, we used two kind of input devices : a 3D mouse and an isotonic device. The target was a cube presented in a 3D room. The 3D context is configured by three factors which are texture, shadow or no shadow to the pointer and shadow or no shadow to the target. The results have shown the superiority of using isotonic input device and the usefulness of the shadow for a guidance in a 3D computer environment.

1. Introduction

Recent developments for a 3D interactions showed that people had trouble in identifying the depth of a visual scene [Wanger & al, 1992; Carr & England, 1995] when using 3D input devices. The user identified with difficulty objects when the depth and the distance inside the scene was important.One explanation of this finding is that sources of information signaling depth in a given (for instance, the depth cues) may not be sufficient to indicate the full depth of the object object in the computer 3D environment. It was observed [Gombrich, 1995; Cavanagh & al , 1989; Puerta, 1989] that shadows significantly enhance the depth perception in everyday reality. The shadow of objects provide hints on spatial relationships and the depth [Slater & al, 1995]. Typically the 3D computer environment does not support shadows whereas the simple task of pointing or moving to an object can be confusing when the distance of the target cannot be easily determined within the scene or within a specific frame of reference. Shadows caused by one object are a powerful source of information for the spatial position, the localization of an object and depth relations in a computer scene 3D. [Wanger & al, 1992] showed a dominant effect of shadows for object locations in judge task. The shadow enables users to infer both the position and the location of an object. The gap between an object and its shadow indicates the object's height above the ground plane. The location of a shadow on the ground plane indicates the object's distance. We hypothesize that shadow cues provided by objects and the dynamic shadow cues provide by the pointer influence the access to the depth and distance perception. They enhance the guidance for pointing an object in 3D scene and the pointing performance. The user is enabled to use static shadow informations and dynamic shadow informations to guide actions, to achieve a particular goal and make decisions in a three-dimensional world. A relevant aspect is that many users have little or no experience with input 3D devices to navigate in a 3D space.

In this framework, our study has a double objective. First, to determine which are the visual and relevant contextual hints allowing the guidance of actions in an 3D environment. Second, to study the compatibility of the traditional and isotonic input (Owl) devices during a motor activity requiring of the speed and the precision.

2. Method

2.1. Subjects

Nine subjects with normal or corrected vision volunteered to participate in the experiment. They performed a pointing task in a 3D computer environment. The right or left handiness was controlled too. They all preferred to use their right hand in this context. None of the subjects were familiar with the hypotheses investigated in the experiment.

2.2. Apparatus

The experimental apparatus consisted of a twenty one inches screen. This screen was supported the 3D interface is represented as a 3D room made up of two adjacents walls, a floor and a ceiling and a lighting whose luminosity is constant. At the interior of this scene, a cube and a pointer are presented. The input devices are of two kinds : a 3D mouse (figure 1) and an isotonic input device which is called Owl (figure 2). A degree of freedom was added to the mouse by means of the arrows of the keyboard, thus the axis y is supported by the arrows (up-down) of the keyboard. The Z and X Axes were browsed with the mouse.

Figure 1. The 3D mouse

Figure 2. The isotonic input device: owl

The isotonic input device (Owl) moves with the user, and has no resistance. The device consists in a transmitter with ultrasounds fixed on a ring and a sensor placed around the screen. It comprises the three degrees of freedom (x,y,z). The configuration of the 3D context depends on the three following variables: (1) texture (T) comprising two modes, squared and non squared, (2) static shadow of the cube (C) including two degrees, cubic echo and without cubic echo, (3) dynamic shadow of the pointer (P) consisting of two modes, pointer echo and without pointer echo.

2.3. Procedure

Two experimental sessions were conducted. The first one was carried out by using the 3D mouse and the second one was carried out by the isotonic input device. Before initiating the session, the subjects were given a practice trial to be accustomed them with the response device and the handling the input device (the 3D mouse or Owl). The subjects sat in front of the screen at a distance of approximately 70 cm. The task consists in pointing the cube as fast as possible. When the subject thinks of having reached the target, it validates its response by a click (mouse down). A beep sound is emitted if a correct answer is encountered. Following this one, the subject must reposition the pointer in its initial position , i.e. at the bottom of the screen. In the menus of the interface, the experimenter selected properties corresponding to the selected condition. As soon as the cube and the pointer appeared on the screen, the chronometer starts and stop with the beep sound. For each subject the presentation order of the target and the position of the cube was randomized. The time between the beep sound and the presentation of the following cube was two seconds. For each experimental presentation eight conditions were investigated: texture, shadow of the cube, shadow of the pointer and the type of input devices. The conditions resulting from the combination of the variables presented previously. Each subject completed a total of 160 trials For each condition, the subject performed a block of 20 trials at a time. The order of presentation of experimental conditions was counterbalanced across subjects.

3. Results

The number of clicks and the reponse time to point the cube correctly were recorded for each presentation and the eight conditions. A within-subjects means for all dependents measures were calculated from the pointing time and the number clicks for each combination of texture (T: squared vs no squared), the shadow of the cube or target (C: echo vs. without echo), the shadow of the pointer (P: echo vs. without echo) and the type of input device (O: 3D mouse or owl). For each dependent variable, an ANOVA was performed on a subjects **x** texture **x** shadow of the cube or target **x** shadow of the pointer **x** type of input device. The ANOVA performed on the pointing time reveals the presence of a significant effect of the input device ($F(1,120) = 31.51, p<.01$), a significant effect of the static shadow of the target ($F(1,120) = 11.89, p<.01$) and a significant effect of the dynamic shadow of the pointer ($F(1,120) = 13.393, p<.01$). Conversely , there is no significant effect of the texture. The users are faster to point the target with the owl (9081.27 ms) than with the 3D mouse (13743.49 ms). In the same way, they point the cube more quickly in the presence of a static shadow with the target (10037.12 ms vs. 10787.65 ms) and, also in the presence of a dynamic shadow with pointer (9952.907 ms vs. 12871.86 ms).

The interaction between the dynamic shadow of the pointer and the type of the input device is significant ($F(1,120) = 4.0098, p<.05$). The result means that the effect of the dynamic shadow to the pointer differs according to the type of the input device and vice versa, meaning that the effect of the input device type is not the same one according to the presence or not of dynamic shadow to the pointer. To refine these results, we have realized contrasts. About use of the mouse 3D, we observed different performances in the situation of the dynamic shadow to the pointer compared to the situation where there is no dynamic shadow below the pointer ($F(1, 120) = 16.03, p<.01$). The subjects spend less time to point the cube in the presence of a dynamic shadow with pointer (11512.42 ms) that in absence of a dynamic shadow to pointer (15974.58 ms). On the other hand, with regard to the use of the owl, there is no significant difference according to the presence or not of the dynamic shadow to the pointer.

For the presence of dynamic shadow to the pointer, the speed of pointing is different according to the type of the input device used ($F(1,120) = 6.52, p<.05$). The users point more quickly the cube having an shadow with the owl (8393.38 ms) that with the mouse 3D (11512.42 ms). This effect is more marking when there is no dynamic shadow with the pointer ($F(1, 120) = 29.001, p<.01$). The subjects are faster to point with the owl (9769,4ms) that with the mouse 3D (15974.58 ms). The ANOVA carried out with the number of clicks to deliver the correct answer showed us that there is a significant effect of the static shadow of the target ($F(1,120) = 3.33, p<.10$) and a significant effect of the dynamic shadow of the pointer ($F(1,120) = 6.228, p<.05$). For the other variables, no significant differences have been recorded. The users produce less clicks to point the target when there is a static shadow with the target (2.356 vs. 3.173) and a dynamic shadow with the pointer (2.221 vs. 3.307).

In short, the subjects performances were better when the input device used is the owl, when there is a shadow as well with the pointer as with the target. However, this can be modulated. Indeed, when the input device used is the 3D mouse, the users spend less time to point the target when there is a dynamic shadow to the pointer. Conversely, this conclusion is not valid any more when the owl is used. With a dynamic shadow or not to the pointer, we always observe a superiority of the use of the owl. These results are compatible with our hypotheses (1) the performance of the subjects in a pointing task should be of higher degree in the presence of a shadow and this, that the shadow either presents to the target or the pointer, (2) the use of Owl should facilitate the pointing of the target, (3) the shadow of the pointer should help the pointing of the target, this more especially as the used input device is the 3D mouse.

4. Conclusion

In this study we investigated the influence of static to the target and dynamic shadows to the pointer in according to 3D input devices on the pointing task in a 3D computer environment. The results indicated that the subjects point more quickly the target when the input device is isotonic. The dynamic shadow to the pointer and the static shadow to the target help the pointing. However, we can note that the performance of the users with 3D mouse is better when there is a shadow to the pointer. The owl is sufficed for itself and that the shadow with the pointer proves to be especially a guide when the input device is the mouse. But one cannot neglect dimension shadow because it facilitates the pointing. It seems that to interact with a 3D environment, the owl appears more usable than the 3D mouse. The relevant contextual hints are the static shadow with the target and the dynamic shadow with the pointer, especially the dynamic shadow with the pointer when the input device used is the mouse 3D. It seems that to mitigate the lack of mobility in an 3D environment via the 3D mouse, the users are based on

dynamic shadow dimension with the pointer to guide itself in this environment. The static shadow provided a ground plane relative reference for height and distance of the target [Wangner, 1992] whereas the dynamic shadow gives information concerning the depth [Slater et al 1995]. The dynamic shadows indicate to the subject the distance between the target and the pointer. The combination of the static and dynamic shadows enhances depth and distance perception when the subject must achieve a particular goal in a 3D world. The shadows provide a guidance framework for actions and enhance the pointing performance in a 3D scene.

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Business and Legal Reality for Virtual Companies in the Internet

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Abstract: Virtual cooperation is for small and medium enterprises a way to stay competitive in dynamic and globalizing markets. Therefore a general framework for establishment and running a virtual company was developed within the project SERVICE (European Community, ESPRIT, TBP). Because of the novel nature of virtual enterprises many social, legal and structural problems had to be considered and resolved.

Introduction

As a result of the tremendous increase in functionality and the importance of the information and communication technology (ICT), companies worldwide and in almost every industry are facing globalizing markets, decreasing innovation cycles, increasing complexity of products, services and environment, decreasing half-value time of knowledge, customer markets and a lack of specialists in many areas. Due to these facts even small and medium enterprises (SME) now have to compete in international markets, which previously were reserved to large companies. Therefore four European software ergonomics consultancies (GSM, Germany; SIEM, Greece; System Concepts, UK; UIDesign, Sweden) developed, together with the University of Stuttgart (Germany) and Tampere (Finland) within the European Community project SERVICE an environment for virtual cooperation. But what does "virtual cooperation" mean? Within this project virtual cooperation means to build up a (temporary) network of (international) distributed (changing) members with complementary skills and ICT as central communication and cooperation enabler. In order to get virtual you have to find the right partners, to set up the business and ICT model and to establish a common understanding. There also will be legal and social problems. But if you have fixed your virtual cooperation you can profit from improved flexibility on market demands, dynamic resource allocation, new markets for combined services and products and reduced costs and risk.

Business and ICT Model

The following figure describes the business and ICT model of a virtual consultancy, which we worked out during the set up process. Since nowadays you cannot distinguish between the ICT and the organizational structure, a general framework was developed, which is based on the Internet. As the Internet technologies support all kind of communication, information and storage technologies as well as global access, they provide the best framework for virtuality.

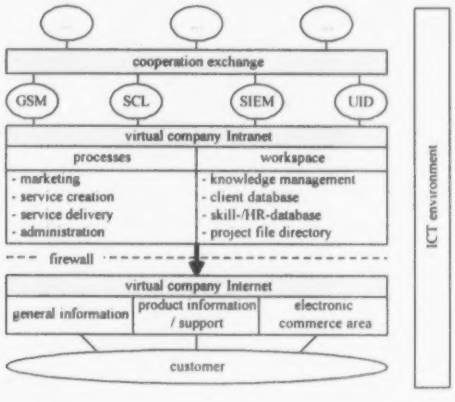

Figure 1: Business and ICT model of a virtual consultancy

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In theory a virtual enterprise is a temporary, spontaneous and non-bureaucratic cooperation of independent companies supported by means of ICT enablers. But in reality you will need some regulations, since social, legal and structural problems will arise (see below).

The difficulties start with the search for the right partners. If a strategic decision or a customer request reveals a lack of resources or competencies in special areas, a *cooperation exchange* can be an appropriate way to find complementary cooperation partners. In order to check whether the selected partners fit in a virtual enterprise and to establish a common understanding a three step process was developed, which includes a questionnaire (ICT and business framework), mutual site visits (company and competency presentations) and a common meeting to start the cooperation. At the end of this process the *ICT model* is established and the *business processes* within the framework are clarified.

But how do you run a virtual company? Since all participants are independent enterprises with different structures, minimum standards must be defined. As the companies are unlikely to want to change their internal business and ICT framework, some interface standards must be defined and a minimum of ICT requirements must be met. The common environment must be provided by the virtual company, i.e. Intranet (common internal workspace) and Internet presentation with Electronic Commerce area, marketing material and product support.

Maybe predefined processes are at first sight in contradiction to the non-bureaucratic ideology, but as often participants are only temporarily linked, there is a need for templates (documents, stationery, as well as rules, roles and behavior descriptions). In addition the demand for quality management and legal correctness requires a minimum of standards. But where do the legal problems arise?

Legal Problems

The Internet is *per se* an international medium. In contrast to that laws are local, inhomogeneous, historically derived and therefore more and more in conflict with fast growing, ICT supported and globalizing markets. Because of the increasing legal uncertainty surrounding the operation of the Internet the business and ICT framework had to be analyzed in detail and separately for every country. Three main Government independent topics could be identified:

- Legal Form and Contract Law (i.e. warranty, brand name, party to a contract, ...)
- Intellectual Property Rights (i.e. commonly developed products, services, documents, databases, etc.)
- Electronic Commerce (e.g. electronic payment, data (transfer) protection, evidential value, taxes, ...)

As there exists no legal form "virtual enterprise", you have to construct that form by means of existing ones. Possible constructions are main-/subcontractor, parent-/affiliated-company or consortium. All models have their pros and cons concerning the customer perception (one face to the client), costs, flexibility and legal certainty.

The intellectual property rights are a very difficult topic. The difference between background information (information/product/licenses that are brought into the virtual company by one partner, who will keep the copyright) and foreground information (developments during virtual cooperation) has clearly to be defined in advance and an IPR-agreement should be signed. That agreement should cover the most probable situations (publication, common developments, licenses, customers, etc.) and define rules and processes how to handle them. For example the license for common developed software could be distributed by the respective country.

Electronic Commerce is an area which has grown, driven by the ICT development, very fast in the last few years. Therefore the legislators are under pressure to keep up with that evolution. For that reason, even after the introduction i.e. of a multimedia law in Germany, topics like digital signatures, place of origin, taxes, electronic payment, brand names, contracting, encryption, etc. are often uncertain.

Conclusion

The "virtual enterprise" is a very competitive model for cooperation in dynamic and/or fast growing markets. Due to the popularity of the Internet all kinds of ICT enablers are available for free or at reasonable costs. Even the legal difficulties can be solved in the form of a legal framework, which contains checked processes, behavior rules and common agreements. In combination with the business framework and the ICT environment a behavior description for all relevant processes on a generic level can be created. Once established, this could be used for dynamic partner allocation, restructuring or as a kind of franchising system, which provides e.g. the environment, a "virtual" brand name and the development of the strategy. But also virtual enterprises consist of real human beings and therefore trust and a common understanding, beside other aspects which couldn't be addressed owing to the shortness of the paper, are highly fundamental to the success of a virtual enterprise.

Developing Web-Based Enterprise Applications with Java, JavaBeans, and CORBA

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Abstract: The major challenge for all organizations is to adapt to profound and rapid changes in business needs and requirements. The Internet has provided organizations with new historical opportunities to face the challenge. This has created a fast growing demand for flexible, maintainable, scalable, and secure Web-based applications. The new trend is to integrate Web with distributed objects, and develop 3-tier Web-based enterprise applications (Web browsers in tier 1, Object Request Brokers (ORBs) in tier 2, and DBMS servers in tier 3). The new promising approach is based on the integration of Java and JavaBeans with CORBA. Java/CORBA-based ORBs enable communication between Java applets or beans running inside Web browsers across different platforms. JavaBeans--the Java-based component technology--helps to develop, more rapidly and economically, new applications. The focus of this paper is on the new approach. The paper presents our experience of adopting this approach, lessons learned, and future plans.
Keywords: JavaBeans, Java, CORBA, Enterprise-Wide Web-based Applications, 3-Tier Architecture, 2-Tier Architecture, ActiveX, Security, Portability, Interoperability.

1. Introduction

In today's highly competitive market, the major challenge for all organizations is to adapt to enormous and rapid changes in business needs and requirements. The Internet has provided organizations with new historical opportunities to face the challenge. This has created a fast growing demand for flexible, maintainable, scalable, and secure Web-based applications. Developing such Web-based applications that cross the boundaries of different hardware platforms, different networking and operating systems, and different programming languages is challenging. The new trend is to integrate Web with distributed objects. The backbone of distributed object-oriented systems is Object Request Brokers (ORBs), which provide a location transparent communication between clients and servers in heterogeneous distributed computing environments.

There are two major approaches to developing 3-tier Web-based enterprise applications; both integrating distributed objects with the Web. The first major approach is based on the integration of Java and JavaBeans with Common Object Request Broker Architecture (CORBA). The second major approach makes use of ActiveX and Distributed Component Object Model [Pour 1998a]. The focus of this paper is on the first approach.

The paper is organized as follows. Section 2 describes 2-tier and 3-tier client/server application architectures. Section 3 reviews two major approaches to developing 3-tier Web-based enterprise applications. Section 4 provides an overview of major technologies adopted in those approaches, discusses how Java and JavaBeans address security issues, compares Java and JavaBeans with ActiveX, and describes the motivation behind the integration of Java and JavaBeans with CORBA. Section 5 is focused on the R&D projects in which we have developed several Web-based enterprise applications by adopting the first approach. Section 6 presents the lessons learned from the projects and our future plans.

2. Web-Based Application Architectures

The architecture of a software system defines that system in terms of computational components and interactions among those components [Shaw et al. 1996]. In Web-based enterprise applications, components fall into three categories: (1) Web clients (also called Web browsers), (2) Web servers, and (3) databases. The interactions among components are client-server protocols and database-accessing protocols. Importance of architecture increases with size--the larger the application, the more attention needs to be paid to architectures [Umar 1997]. The two most commonly used client/server application architectures are 2-tier and 3-tier architectures.

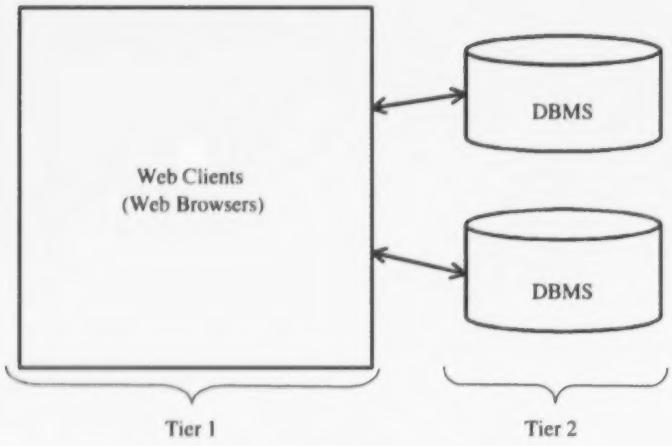

Figure 1: 2-Tier Web-Based Application Architectures

2.1 2-Tier Client/Server Application Architectures

In 2-tier client/server application architectures, clients (front-end) operate in tier 1, and servers (back-end) in tier 2. Clients display results and process all the information; therefore, the model is called "fat-clients". [Fig. 1] shows 2-tier Web-based application architectures where clients are Web browsers, and servers are Database Management System (DBMS). In this model, SQL is used for accessing relational databases. For interaction between clients and servers, there are several protocols to choose from: (1) HTTP for accessing HTML documents and invoking CGI programs, (2) CORBA Internet Inter-ORB Protocol (IIOP) for invoking CORBA objects, and (3) DCOM for invoking ActiveX components and remotely located spreadsheets.

2.2 3-Tier Client/Server Application Architectures

In 3-tier application architectures, tier 1 belongs to "front-end", tier 2 to "middleware", and tier 3 to "back-end". [Fig. 2] illustrates 3-tier Web-based application architectures where Web browsers operate in tier 1, Web servers (ORBs) in tier 2, and back-end corporate resources such as DBMS servers, Lotus Notes, and legacy applications in tier 3. Web browsers display the results, and servers process all the information. Hence compared to "fat-clients", this model requires more powerful servers. This model is called "thin-clients" or "fat-servers". The choices of client-server and database-accessing protocols are the same for 2-tier and 3-tier.

2.3 2-Tier versus 3-Tier Application Architectures

There is a trade-off between "fat-clients" and "fat-servers" models. "Fat-clients" models can be more expensive to support because more powerful client machines and associated software are needed [Umar 1997]. A "thin-clients" model with fat servers is more suitable for enterprise applications because enforcing security requirements and rules of enterprise has high priority. A key trend is the separation of business rules (i.e. the functional logic unique to the user organization) from the presentation (i.e. the functional logic unique to the user organization) from the presentation (user interface) and data management functions of applications. The separation of concerns leads to three types of services in 3-tier application architectures: presentation services, processing services, and data services. This separation promotes interoperability, reuse, and manageability of applications in distributed environments [Umar 1997]. Furthermore, 3-tier architectures provide application developers with more options so they can enhance the scalability, performance, and reliability of application. [Gold-Bernstein et al.1998] reports 4% decrease in development of 2-tier applications from 1996 to 1998, and 200% increase in development of 3-tier software applications during that time.

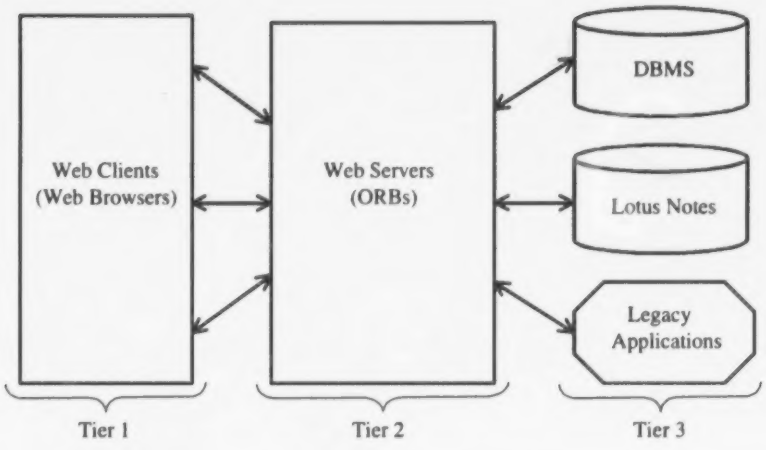

Figure 2: 3-Tier Web-Based Application Architectures

3. Approaches to Developing Enterprise-Wide Web-Based Applications

Web browsers are well suited for human to computer communications, and distributed objects for the computer to computer communications. This has led to developing Web-based enterprise applications through the integration of distributed objects with the Web. There are two major approaches: (1) integrated Java and JavaBeans with CORBA, and (2) ActiveX/DCOM. The first approach was adopted in the R&D projects reported in the paper.

4. Overview and Roles of Technologies

4.1 An Overview of Java

Java is a powerful object-oriented programming language designed and developed specifically for the Web by JavaSoft--an organization in Sun Microsystems. The explosion of the Web and the need for a solid way to bring its interactivity created the perfect climate for an innovative technology like Java [Morrison 1997]. Java introduces a new model for developing distributed application development for the Web. Java promises faster enterprise development, easier systems management, and applications that scale beyond the largest information systems used today [Levin 1997]. The mission statement of Java is "Write once and run anywhere". Java has an elegant and efficient solution to portability and security problems. Its solution lies in the use of portable Java bytecodes. [Fig. 3] shows bytecodes from production to execution. A Java program is an applet or an application. A Java application runs under the operating system of the computer. Java applets can run inside Web browsers. Java compiler located on the server side compiles Java programs into platform-independent bytecodes (not platform-specific binaries). Compiled Java bytecodes can be downloaded on another system located on the client side, and executed by Java interpreter on that system. Java is portable because compiled Java bytecodes can run on any system supporting Java Virtual Machine (VM).

4.2 An Overview of JavaBeans

JavaBeans is a Java-based component technology from JavaSoft. Interest in component technology has grown significantly because enterprise-wide software applications can be developed more rapidly and economically by assembling software components. Software components are reusable building blocks for constructing software systems [Thomas 1997]. The mission statement of JavaBeans is "Write once, run anywhere, reuse everywhere." Java beans are platform-independent; they can run on any platform supporting Java VM. Furthermore, beans are reusable components--can be created, reused, modified, and assembled into new feature-rich applications. A Java bean, according to its creators is "a reusable software component that can be manipulated visually in a builder tool" [Jubin 1998]. The primary usage of Java Beans is as building blocks

of large-scale and complex applications for heterogeneous distributed computing environments--Internet and Intranet.

4.3 Java, JavaBeans, and Security

Java was designed to address security issues of distributed software applications. As explained earlier, Java bytecodes can be downloaded from Web servers to Web browsers, and run on the client side. To ensure downloaded Java bytecodes do not put the client side at risk, Java has adopted the following three different approaches: (1) Sandbox mechanism, (2) Digital signatures, and (3) Trusted servers. Sandboxing guarantees security by not allowing downloaded Java bytecodes to access anything outside the sandbox. The price of sandboxing is limited capability of sandboxed Java bytecodes. The Web browser that downloads a Java bytecode checks the digital signature of the bytecode. If it is verified, the browser trusts the bytecode, and the trusted bytecode can access outside sandbox. The corporate servers can also be trusted not to deliver components that contain viruses or damage the system on which they are downloaded and executed. JavaBeans addresses security issues just as Java does. It adopts sandbox approach. A Java bean can be trusted or untrusted. A trusted bean carries a digital signature that should be verified by a reputable authority before the bean is given an extended access to resources outside the sandbox. An untrusted bean cannot operate outside the sandbox.

Security threats are categorized as system modifications, invasion of privacy, denial of service, and antagonism [McGraw et al. 1996]. "System modifications" are the kind of attacks in which an applet damages or alters the client's machine. "Invasion of privacy" refers to the kind of attacks in which private information is stolen or the applet forges client's identity. "Denial of service" refers to the kind of attacks in which the applet consumes CPU cycles, memory, or other resources. "Antagonism" refers to the kind of attacks that result in annoying behavior such as repeatedly playing sound clips. Java provides strong defenses against "system modifications" and "invasion of privacy" with one exception--a hostile applet forging e-mail. A rogue applet can forge e-mail on the machine running a Web browser, making it look like e-mail that is sent from that machine's user [Savit et al.1998]. Java has the ability to defend against the worst consequences of breach in security and integrity--persistent damage to computing system, and stolen or altered private data. However, it has weak defense against "denial of service" and "antagonism", which cause lost time and low productivity.

4.4 An Overview of ActiveX

ActiveX is the component technology introduced by Microsoft in March 1996 as the company's main strategy for the Web. Microsoft promotes ActiveX as a complete environment for components and distributed objects. ActiveX is based upon Component Object Model (COM). COM components are classes that advertise their services through interfaces. Authorized client components or programs create an object of the component class and get a pointer to the interface providing the services they need. Client components use the pointer to invoke methods on the object and access the object's services. Distributed Component Object Model (DCOM) is the ORB for ActiveX. DCOM serves as a core technology for remote communications between ActiveX components--. ActiveX components can access relational databases through Microsoft's Open Database Connectivity (ODBC).

4.5 Java and JavaBeans versus ActiveX

Java and ActiveX are designed for the Web; each provides executable content by downloading small programs from Web server to the Web browser for client-side execution. A major difference between Java bytecodes and ActiveX controls is that Java bytecodes are platform-independent bytecodes while ActiveX controls are platform-specific binaries. ActiveX in its current implementation is entirely dependent on the Window platform. This is a critical weakness, especially at the time that Internet is at the center of everything. Microsoft may release a platform-independent version of ActiveX in the next few years. At the same time, Java and JavaBeans technologies may expand their Internet market share. ActiveX differs from Java and JavaBeans in the way it supports security. ActiveX relies only on digital signature verification method, and does not support sandbox mechanism. Java and JavaBeans provide higher level of security by supporting sandboxing. However, sandboxing limits the power of beans; only a limited number of beans are allowed to perform all system operations. In terms of security and portability, Java and JavaBeans lead ActiveX. However, with respect to the existing code base, Java and JavaBeans lag ActiveX. ActiveX has considerably large existing

code base due to its underlying OCX technology that is widely used in the Windows software community. This may change as Java and JavaBeans become more popular over the next few years.

4.6 An Overview of JDBC

Java Database Connectivity (JDBC) is a Java SQL wrapper that provides portable and cross-platform database access for Java programs (Java applications and applets). JDBC eliminates the need for a gateway program to access databases. It handles connectivity to relational databases, fetching query results, committing or rolling back transactions, and converting SQL types to and from Java program variables. SQL is used for querying and updating relational databases.

4.7 An Overview of CORBA

Common Object Request Broker Architecture (CORBA) is a set of specifications that provides a standard architecture for distributed computing and standard communication protocols to ensure interoperability between objects running on different hardware platforms, different networking and operating systems, and written in different languages. CORBA was introduced by the Object Management Group (OMG)--the largest software consortium including over 800 computer companies. The OMG was founded in 1989 by a few major computer companies including Hewllett-Packard, Sun, IBM, and Digital. This paper highlights two key components of CORBA. A major component of CORBA is Object Request Broker (ORB) which provides location transparent communication between clients and servers in a distributed heterogeneous environment. ORB takes the client's request, sends it to a server, takes the response from the server, and sends it to the client. Another key component of CORBA is CORBA IDL--a declarative language for defining interfaces of objects so that CORBA ORBs can recognize those objects. A complete description of CORBA can be found in [Pour 1994].

4.8 Interoperability

All the competing technologies covered in the paper are evolving to become more powerful; therefore, the demand for bridges that provide interoperability between those technologies has increased significantly. So far, the following bridges have been developed: (1) COM/CORBA bridge by Iona, (2) JavaBeans/ActiveX bridge by JavaSoft, and (3) JDBC-ODBC bridge by JavaSoft. However, the competition between these technologies continues.

4.9 Integration of Java and JavaBeans with CORBA

CORBA provides Java with a distributed object platform; it allows Java applets to communicate with objects running on different hardware platforms, different networking and operating systems, and written in different programming languages. CORBA is a good replacement for HTTP/CGI, which is very slow and inefficient. Java provides maintainability, extendibility, portability, and robustness. CORBA deals with network transparency while Java deals with implementation transparency. Furthermore, JavaBeans augment CORBA with a portable and toolable component infrastructure [Orfali et al.1998]. CORBA provides a foundation for applying component-based software development approach to build enterprise applications in heterogeneous distributed environments [Pour 1998b]. Therefore, the integrated Java and JavaBeans with CORBA provide a very good model for creating Web-based enterprise applications.

5. R&D Projects

The main objectives of our R&D projects include: (1) Developing several 3-tier Web-based applications through the integration of Java and JavaBeans with CORBA, (2) Providing for our graduate students the opportunity to work with fast-evolving technologies, gain hands-on practical experience in integrating several cutting-edge technologies, and complete their Master research projects, and (3) Incorporating the results of the R&D projects to our on-going research focused on component-based engineering of Web-based enterprise applications.

5.1 Hardware and Software Resources

The projects were carried out in the Client/Server Laboratory at San Jose State University. The lab has a network of 4 workstations and 25 PCs running Windows NT 4.0. The following software products were used to develop the applications: (1) Visigenic's Visibroker for Java 3.1, (3) Symantec's Visual Café 2.1, (4) JDK 1.1.5, (5) Microsoft SQL Server 6.5, (6) Netscape Communicator 4.04, and (7) Netscape Enterprise Server 3.0. Updating the software to the latest version was done routinely.

5.2 Project Constraints

My graduate students participated in the implementation and testing of the applications. They had some knowledge of Java, but very limited understanding of CORBA and JavaBeans when they started to work on the projects. Lack of students' working experience with JavaBeans and Java/CORBA-based ORBs was the major external constraint in the projects. On average, it took each student six months to learn, come up to speed, and complete the implementation and testing of one 3-tier Web-based application.

5.3 Evaluation of Results

We developed several 3-tier Web-based enterprise applications such as warehouse management system, computer store, customer survey system, and employee service center. The applications were evaluated by industry representatives, current/potential employers of the students, and several faculty members--including the author--with industrial experience. The metrics used for evaluation were scalability, flexibility, manageability, performance, user-friendliness, and reusability. The results have been very encouraging.

6. Lessons Learned and Future Plans

Adopting JavaBeans technology helps to reduce significantly development time of Web-based enterprise applications. Hence, it would be beneficial to provide the opportunity for students to learn and use JavaBeans on a couple of smaller projects before they start working on similar R&D projects. Such projects provide an opportunity for students to gain working experience with rapidly evolving technologies such as JavaBeans, Java, and CORBA, and to integrate those technologies to develop 3-tier Web-based enterprise applications. This experience has proven to be extremely valuable for students. Industry has been supportive of the projects. The results have been incorporated to our on-going research on component-based engineering of Web-based enterprise applications. The projects have been beneficial on all accounts; therefore, we plan to continue similar R&D projects.

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Web Course in a Box - Student Perspectives

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Many universities are moving toward the use of electronic materials and online coursework. While this is particularly convenient for undergraduate students who are living on campus, what are the implications for graduate students living off campus? Approximately 65 graduate education students were asked what they liked most and least about using Web Course in a Box, a software that allows instructors to integrate the Internet into their classes without writing HTML or knowing a computer programming language. The researcher looked at the relationship of students' attitudes toward electronic syllabi including email, weblinks and discussion topics, and these same students' interest in taking web-based distance education courses.

WWWPal - A System for Analysis and Synthesis of Web Pages

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Abstract: WWWPal is a system that helps in the analysis and synthesis of Web documents. The system eliminates a common problem of obscure organization of Web documents in Web information systems. WWWPal consists of the following six components: 1) Web Robot, 2) Graph Visualizer, 3) Graph Analyzer, 4) Clustering Tool, 5) Synthesizer, and 6) Interface Package. The Clustering Tool is used to partition the nodes of the graph in different clusters using several heuristics. The partitioned graph is used to get better overall site maps of the Web server. In addition, this Clustering Tool helps in the visualization of large graphs. The Synthesizer helps to create a skeletal HTML document from a given graph. The Synthesizer interfaces with ASHE (A Simple HTML Editor) to edit a document. An interface package enables our system, WWWPal, to communicate with a browser, such as Netscape. This interface and Graph Visualizer form a skeletal graph browser (of the URLs) in our system.

1. Introduction

A number of systems have been developed in the past few years for the analysis of web pages. Systems such as WebCutter (Mapuccino) [Maarek & Shaul 97], WebQuery [Carriere & Kazman 95] [Carriere & Kazman 97], WebCiao [Chen & Koutsofios 97] and SiteHelper [Ngu & Wu 97] have been recently reported to perform organization of Web documents. Our system, WWWPal, is different from those as our system can handle large graphs [Isakowit et al. 95] [Piroli et al. 96] [Sano 96] [Takahashi & Liang 97], has a better display using clustering algorithms, has a skeletal graph browser, and has an interface to the HTML Synthesizer and browser. WWWPal is modular and more functionality can be added, if necessary. Our system can also synthesize site maps in many different forms.

We present the design, implementation, algorithms used, and examples of WWWPal in the following sections.

2. System Overview - Components of the System

The components of the System are:

- Web Robot: This component is responsible for navigating through Web sites and gathering raw data (Web graph). The input is the given initial URL and the output is a collection of nodes and edges, representing the URLs and the connections, respectively. Protocol information, such as HTTP and FTP, is an attribute of a node.
- Graph Visualizer: The visual interface is designed to display general graphs. Properties of nodes are label, color, shape, weight, and metadata information. Properties of the edges are color and weight. These properties help us visualize general Web graph information such as types of files, protocols used, size of web documents, titles, dates of creation, etc. The visual interface interacts with the graph library to display graphs in different kinds of drawings [DiBattista et al. 93] [Mukherjea & Foley 95] that include radial, spring-loaded (to model edges as springs) [Fig. 2] and incremental. It is possible to display graphs with 200,000 nodes. This module has three main functions: browsing graphs, creating and editing graphs, and helping Web navigation using an interface with a Web browser, such as Netscape.

- Graph Analyzer: This tool has a number of modules (filters) to analyze the constructed Web graph. These filters help the user obtain specific data from the Web graph. They report groups of nodes that are related under specific properties. It is easy to add additional modules to the Graph Analyzer. Examples of filters that are implemented: 1) Pages of a specific user; 2) Broken links; 3) Web books, filtered following the HTML tag LINK or groups of nodes that are related under a specific property; 4) Linearization of a Web graph, used for printing Web documents; 5) Site Maps, reported using Web graphs [Fig. 4] or HTML files as lists or tables [Fig. 5]; 6) Popular paths of a Web site, achieved using log files of the Web server; 7) Report of problems of a Web site such as HTML pages that are large or dead ends (no outgoing hyperlinks).
- Clustering Tool: This tool helps to visualize large Web graphs. If the number of nodes of a given Web graph is larger than a given number, the Web graph is partitioned using clustering algorithms. Our system currently has three clustering heuristics.
- Synthesizer: The Synthesizer helps create a skeletal HTML document from a given graph. Synthesizer also interfaces with ASHE to edit a document.
- Interfaces: The system currently supports two interfaces. The interface with Netscape helps navigate a URL interactively. The user sees the corresponding graph to that URL in the visual interface that is generated when he/she navigates the Web. The second interface is with the ASHE (xhtml) HTML editor that helps edit the content of any Web node that is an HTML document.

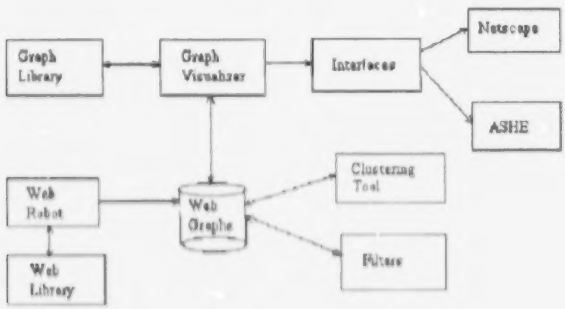

Figure 1: Components of the WWWPal System.

The whole system is implemented in C (in an object-oriented fashion). We have used the Libwww and Motif libraries. An important feature is that our system consists of a number of modules (such as graph library, graph analyzer) which others can use as libraries. Our whole system currently runs under Solaris 5.2 and can be ported to Linux. The system (binary image) takes 1 M in storage.

3. Web Robot

WWWPal System uses Libwww from the World Wide Web Consortium. The Web Robot is based on webbot of the Libwww and it uses the Web Library to navigate automatically in the Web. Parameters given to the Web Robot are the initial URL, depth of navigation, and conditions of navigation. The initial URL is where the Web Robot starts the navigation and continues using a Breadth-First Search (BFS) algorithm. The depth of navigation is a parameter of the Robot to prevent it from navigating infinitely in the Web. Other parameters of the navigation are names of Web servers and conditions such as which directories are allowed to visit or not. The output of the navigation is a text file that describes the Web graph generated by the Robot. [Fig. 2] shows a sample output of the graph from navigating the WebNet site.

The Web Robot handles recursive paths, redirection of URLs, and semantically incorrect URLs. All visited URLs are kept in hash tables to maximize the performance of the navigation time.

Furthermore, the Web Robot uses the standard file "robots.txt" to obtain additional information for visiting Web sites. This information determines the Web directories the Robot is allowed to visit and the directories the Robot is not allowed to visit.

The Web Robot gathers meta information from each Web Node such as title of document, size of document, date, mime types and general HEAD info (LINK, META tags). Each Web Node is given in a unique number the first time the corresponding page is first visited by the Web Robot. This information is important for visualization of the Web graphs and for the system graph Analyzer. The Robot saves this information as properties of a Web Node.

The Robot traversal takes the longest time in our system. Because the system saves the Web graph in a plain text file, large sites tend to produce large Web graphs. From our current experience, we found that for a medium-size computer science department, the Web graph file was 6 M bytes; for a medium-size technical university, the Web graph was 12 M bytes; and for an average user or a medium-size company, it was 0.1 M bytes. For example, the Web graph for the WebNet site on 02/20/98 was 0.01M bytes.

4. Graph Visualizer

The Graph Visualizer is designed to display large graphs. Graphs can be directed or undirected and the nodes can have different geometrical shapes. The Graph Visualizer interacts with a Graph Library that we developed. The Graph Library stores information about nodes and edges in structures that can be accessed through hash tables. Labels (identifiers) and positions are the sources used to generate the hash numbers in order to store and access this information.

The Graph Library has several methods of drawing graphs such as a horizontal tree, vertical tree, radial tree, barycentric, spring algorithms, circular, as well as incremental algorithms. These different drawing algorithms use "heuristics" to place the vertices of a graph according to "some specifications" so that the resulting embedding of the graph looks "nice." The Zoom function helps to look at a graph in great detail or to get an overview of a graph. The Graph Library allows the user to change information of nodes and edges so the Graph Visualizer can edit the graph. Graphs can be saved in text format, which can be read by the Graph Library's parser. The Graph Library is object-oriented so it is easy to add other methods to read different graph file formats. It is also easy to add more drawing methods.

The Graph Visualizer of the WWWPal system interprets the information of nodes and edges of the graph in this way:

- URLs are the label identifiers of the nodes of the graphs.
- Shapes of nodes are set depending on the protocol of the URL. For example, squares are visited web documents, circles are non-visited web documents, rhombi are ftp documents, ellipses are mailto URLs, triangles are broken links, etc.
- Colors of nodes represent types of documents such as HTML files, text files, compressed files, image files, etc. This information can be set using the mime type of the Web Node.
- The Web Graph can be represented as a tree using either DFS (Depth-First Search) or BFS (Breadth-First Search) from an initial Web Node. The Graph Visualizer assigns a color to the edges so we can distinguish between the Tree edges (blue), Forward edges (cyan), Backward edges (green) and edges to unreachable Web Nodes (magenta).
- We can partition the graph using the selection methods of the Graph Library. Selection can be individual, global, children of a Web Node, subtree of the Web Graph, and Web Nodes with related property such as URL templates. Once the selection is made, the Graph Visualizer can partition the graph in two new graphs: One graph contains all selected nodes, this graph is called "Browse Graph." All non-selected vertices and a new node that groups all selected nodes form the second graph. The shape of this node is a pentagon and the label identifier can be the URL of the file where "Browse Graph" is saved. Clicking the mouse in the "Group Vertex" opens a window with the "Browse Graph."
- The Graph Visualizer interacts with ASHE (xhtml) and Netscape to edit or browse any of the Web Nodes.

Graph Visualizer can display large graphs (200,000 nodes). We recommend partitioning large graphs into medium-sized graphs (~ 500 nodes) so drawing of the graph is reasonably fast. The Clustering Tool of the WWWPal system can make an automatic partition. A sample graph of the WebNet site under a spring-loaded embedding is shown in [Fig. 2].

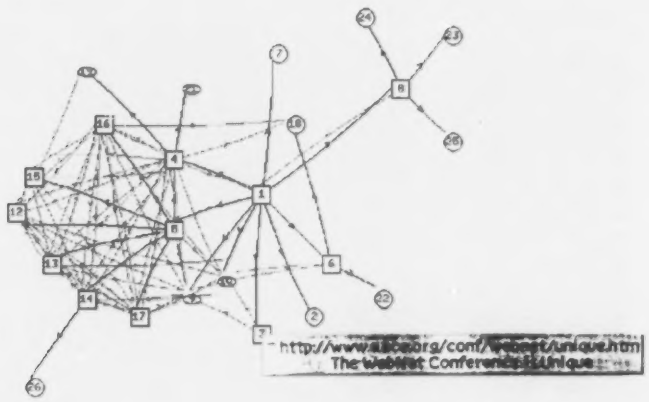

Figure 2: Web Graph of the WebNet Site (spring-loaded embedding).

Web graphs can be displayed as a hierarchical list of documents. If one of the Web Nodes has children, this document is displayed as a directory of the list. We used the ListTree Widget of Robert W. McMullen. [Fig. 3] shows the WebNet web site as a hierarchical list of documents.

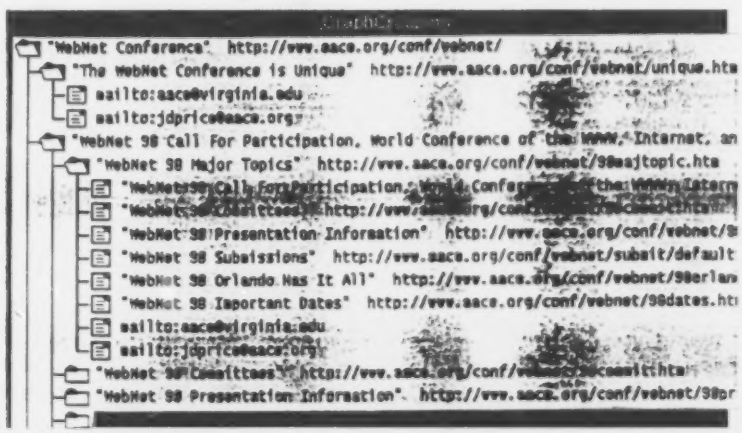
"WebNet Conference" http://www.aace.org/conf/webnet/
"The WebNet Conference is Unique" http://www.aace.org/conf/webnet/unique.hta
mailto:aace@virginia.edu
mailto:jdprice@aace.org
"WebNet 98 Call For Participation, World Conference of the WWW, Internet, an
"WebNet 98 Major Topics" http://www.aace.org/conf/webnet/98majtopic.hta
"WebNet 98 Presentation Information" http://www.aace.org/conf/webnet/9
"WebNet 98 Submissions" http://www.aace.org/conf/webnet/submit/default
"WebNet 98 Orlando Has It All" http://www.aace.org/conf/webnet/98orlan
"WebNet 98 Important Dates" http://www.aace.org/conf/webnet/98dates.ht
mailto:aace@virginia.edu
mailto:jdprice@aace.org
"WebNet 98 Committees" http://www.aace.org/conf/webnet/98committee.hta
"WebNet 98 Presentation Information" http://www.aace.org/conf/webnet/98pr

Figure 3: Web Graph of the WebNet Site shown as a hierarchical list of documents.

5. Clustering Tool

The Clustering Tool of the WWWPal system helps partition the graph using heuristic algorithms. There are two major reasons why the system performs clustering algorithms. The first reason is in visualization of large graphs. Clustering [Broder 97] [Stor y 96] nodes reduce the size of the graph. The second reason is to get a site

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map of a given Web site. We have implemented three algorithms and the user can apply any one of them on a Web graph. All three algorithms are recursive and they follow this general algorithm.

```
URL selectandgroup(URL urlbase,Graph g)
{
  Graph g1,g2;
  URL url1,url2;
  g1 = select(g);
  if (selection conditions are met) {
       save g in a new url;
       return new url based on urlbase;
  } else {
       g2 = group(g,g1);
       url1=selectandgroup(urlbase, g1);
       update g2 with url1;
       url2=selectandgroup(urlbase , g2);
       return url2;
  }
}
```

The essence of this algorithm is to first select a subset of nodes (g1) so that the selected nodes are more related than the rest of the nodes. From this, two graphs are generated: a browse graph (g1) and a group graph (g2). The new vertex group in the group graph (g2) is updated with the location of the browse graph (url1). The parameters of the algorithm are the minimum number of nodes in the graph (MIN_NODES) and the minimum number of the selected nodes (MIN_SEL_NODES). If these parameters are met, a new selection of nodes is made and the process is repeated recursively.

All three heuristics are different in the selection of the nodes. For all three heuristics, a BFS algorithm first classifies the edges of a Web graph. Once the clustering is done, the clustered nodes are represented as pentagons. There is an edge between any two clustered nodes, if there is an edge between any node in one cluster to any node in the second cluster.

The first clustering algorithm counts the number of nodes of the subtree of the immediate children of the root node. The subtree that has the larger number of nodes and is bigger than the parameter MIN_SEL_NODES is selected. If the number of nodes in the current graph is smaller than the parameter MIN_NODES, no selection is made. The first clustering algorithm has been used to get site maps for medium-size companies.

The second clustering algorithm chooses a group of nodes with the same URL template. For example, all web nodes that are under http://www.cs.rpi.edu/guide97/ form a tree. This helps us to visualize a cluster of nodes that are related with the same pattern of URLs. The second clustering algorithm has been used for an average user.

The third clustering algorithm is designed for a large Web site. First the selection is made by the user using the second algorithm (for example, the URL template http://www.cs.rpi.edu/~moorthy/* describes all Web nodes of the user moorthy). When no selection can be made, the first algorithm is applied to partition the graph in smaller graphs. This algorithm can be used to visualize the Web graph as a set of Web graphs of the users' Web sites. The third clustering has been used for a Web site consisting of several users. It has been effectively used to obtain site maps of university web sites.

These clustering algorithms generate a new graph that contains an overview relation between all generated graphs. The shapes of the nodes of this graph are hexagons and the identifiers are the URLs where the files of the graphs are saved. This graph is always a tree and helps the user visualize the whole structure of a large Web site. [Fig. 4] shows, on the left, the Web graph overview of the Computer Science Department at Rensselaer Polytechnic Institute Web site and shows, on the right, the subgraph of the nodes that are clustered in the root node of the graph on the left. It is also possible to get an HTML site map from the clustering algorithms, as described in the next section.

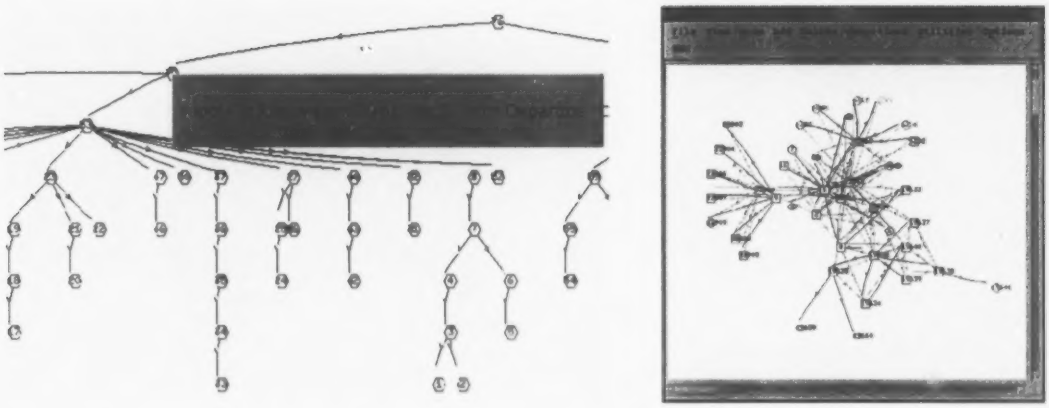

Figure 4: Web Graph of the Web Site of the Computer Science Dept. at Rensselaer after clustering (left) and the First Node of the Web Graph (right).

6. Graph Analyzer

Graph Analyzer has a number of modules (filters) to analyze the constructed Web graph. These filters obtain specific data from the Web graph. They also report groups of nodes that are related under any specific property.

These filters are graph algorithms with the following caveats that the graphs are very large (so the storage space for these algorithms is limited) and there are a number of attributes associated with nodes of the Web graph. In this section, we describe a few filters that we have found useful.

- Pages of a specific user. This is accomplished by traversing the Web graph from the Web node root of the user and selecting all those nodes whose URL's have the user name. We also select one more level beyond the last level.
- Broken links. These are the nodes whose URL's point to a nonexistent document. These are obtained from the Web graph and they are triangles in shape.
- Web books - These are filtered following the HTML tag LINK or groups of nodes that are related under a specific property: URL template or graph cluster. For example once we apply a latex2html to a document, we get a collection of HTML documents and we lose the structure of the document. This structure can be regained by following the URL template property.
- Linearization of a Web graph. This can be used for printing the Web document. This specifies a particular traversal of a graph. When we print the whole book, we assume that individual pages are printed properly.
- Site Maps [Bevirt 96]. These are reported using Web graphs or HTML files as lists or tables. This site map is obtained from the clustering algorithm described in the last section. The site map is obtained by meaningfully expanding the clusters at various levels. The site map of AACE (Association for Advancement of Computing in Education) web site in tabular fashion is given in [Fig. 5]. If we have a different format for a site map, that could also be generated fairly easily.
- Popular paths of a Web site. This is achieved using log files of the Web server. These are obtained as attributes of nodes in a Web graph.
- Report of problems of a Web site such as HTML pages that are huge or dead-ends (no outgoing hyper links). It is often desirable to have a pointer back to the previous or home page in a given HTML document. The dead-end nodes are those Web nodes, which do not have any edge going out of them in the Web graph.

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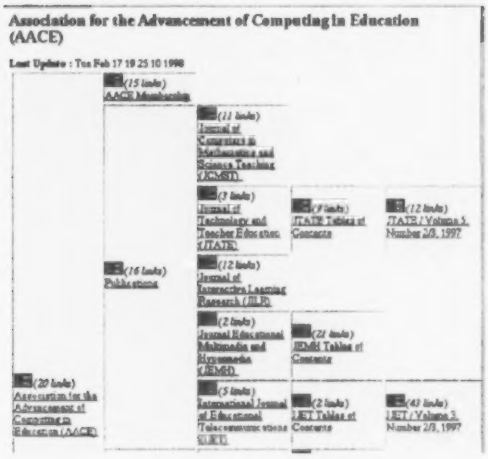
Association for the Advancement of Computing in Education (AACE)
Last Update : Tue Feb 17 19:25:10 1998
(15 links) AACE Membership
(11 links) Journal of Computers in Mathematics and Science Teaching (JCMST)
(7 links) Journal of Technology and Teacher Education (JTATE)
(9 links) JTATE Tables of Contents
(12 links) JTATE / Volume 5, Number 2/3, 1997
(16 links) Publications
(12 links) Journal of Interactive Learning Research (JILR)
(2 links) Journal Educational Multimedia and Hypermedia (JEMH)
(21 links) JEMH Tables of Contents
(20 links) Association for the Advancement of Computing in Education (AACE)
(5 links) International Journal of Educational Telecommunications (IJET)
(2 links) IJET Tables of Contents
(43 links) IJET / Volume 3, Number 2/3, 1997

Figure 5: Site map of AACE Web Site (Table view).

7. Applications

WWWPal has a number of applications, some of which have been mentioned earlier. In this section, we mention two other applications of the system: 1) Graph Browser and 2) HTML Synthesizer.

7.1 Graph Browser

In our graph visualization module, it is possible not only to edit, create, display and modify graphs (Web graphs), but also to open a URL. When a URL is specified, a node gets created and displayed. Furthermore, all the links that are connected to that URL are displayed as edges originating from that Web node. Now, interactively, we can explore any node in the created graph (Web graph). When that node gets explored, all the links connected to that URL page get created as edges emanating from that node. If a Web node has already been visited, it is no longer expanded. If one wants to look at the content of any Web node, then by using either ASHE or Netscape interface, one can see the actual content of the URL. Thus, we have created a browser, which may be thought of as an overview browser. The advantage of this kind of browser is that it does not load the URL document itself, but only gets the information such as the type, size, link and the protocol. [Fig. 7] shows a sample browser of the home page of one of the authors.

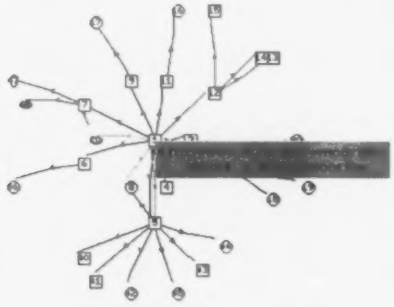

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Figure 7: Web Graph generated after navigating in a Web Site

7.2 HTML Synthesizer

WWWPal also helps us create an outline of a HTML document. Using the graph Visualizer module, a user starts by creating Web nodes and edges joining these Web nodes. The user also specifies the URL attributes of the Web nodes and the order of traversal. WWWPal provides an option of creating a URL document for the created Web Graph. The created URL document consists of only links and does not contain any text or images. The contents (textual, image and audio) can be added using ASHE [Punin & Krishnamoorthy 94], which has been interfaced with our system.

8. Conclusion

This paper describes the WWWPal system that we designed and implemented. Our system is useful for both analysis and synthesis of Web Documents. WWWPal also helps in the organization of Web sites. We have provided a number of examples to illustrate the uses of our system. Our future work involves adding more modules to Graph Analyzer and to obtain many different types of Site maps. Our immediate future work is to make our system freely available to all interested Web servers and clients.

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Developing Electronic Meeting Minutes on the Web

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Abstract: This paper presents a Web-based technique for creation of minutes for electronic (computer-supported) meetings. The minutes are developed by the *secretarius* (a participant responsible for administrative meeting activities) using a novel and unique process. Input into the process includes both analysed meeting discussion and the re-use of summary points used during the meeting review at the end of the meeting. The *Meeting creation tool* is a Web page that updates dynamically for each minute compiled. Each form in the tool is configured specifically with information for assisting the secretarius in determining the details of each minute. A number of Web user interface elements and mechanisms are applied effectively in the structure and function of the tool (such as frames or popup menus). The mechanism for minutes creation is covered. Web user interfaces of the tool used by the secretarius are shown and described.

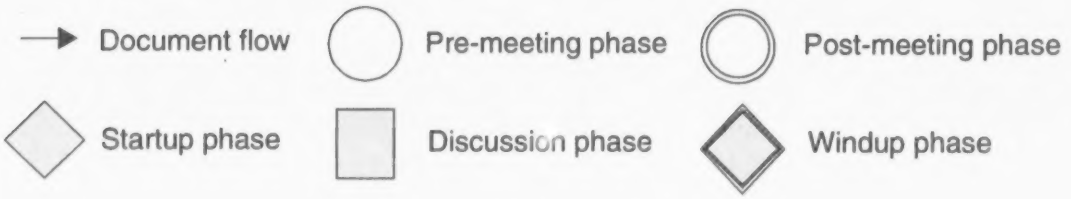
Introduction

The minutes are a widely-used form of summary of a formal meeting. A formal meeting is one that is driven by an *agenda* of discussion items. [Burleson 1990] describes the minutes as 'a contemporaneous history of your {the group's} activities'. Minutes are an important document reflecting the achievements and outcome of a meeting. From this resource, the group that meets at intervals can comprehend retrospectively the output of the meeting in a future meeting. Such comprehension is essential in the following meeting where the minutes must be reviewed briefly before discussion of the current meeting's agenda items is to commence.

Logan [Raikundalia and Rees 1995] [Raikundalia and Rees 1996] is a *Web Electronic Meeting Document Manager* (WEMDM). A WEMDM supports several document issues such as the creation and application of minutes. The WEMDM is used in conjunction with a discussion tool that displays and captures verbatim remarks. A meeting conducted with Logan involves both the roles of *chairperson* (the same as the role in a traditional, face-to-face meeting) and a *secretarius*, which is a participant assigned various administrative meeting tasks such as minutes creation. These participants together are referred to as the *officials* of the group of participants. [Raikundalia and Rees 1995] presents architecture-related and meeting-support issues of Logan.

Logan supports a five-phase meeting structure shown in [Fig. 1(b)]. The five phases are shown in [Fig. 1(a)]. The meeting structure consists of three phases—*pre-meeting*, *in-meeting* and *post-meeting* phases—where the in-meeting phase is divided into *startup*, *discussion* and *windup* phases. The in-meeting phase is represented by shaded objects. Such meetings occur in a chain—a linear sequence of meetings.

Summary points are points created by the secretarius during the discussion phase and are used to review a meeting. The secretarius generates points for an agenda item while that item is being discussed. Summary points contain brief information that remind participants of the outcomes of discussion of an item. The points are entered into the discussion tool by the secretarius during the windup phase. Participants view these points in the discussion tool to review the outcome of the meeting. Two summary points are shown in [Fig. 3] (in the top, right-hand component of the Figure). Each point consists of a point number and the point itself ('Point'). For instance, point 3 indicates that a participant, Peter, suggested certain improvements to an interface during discussion of the given item.



(a)

(b)

Figure 1: Diagrammatic key of meeting components

Logan also performs analysis of meeting *logs*. Logs are transcripts of discussion containing details such as the participant making a remark and the time at which this remark was made. These logs are not easily readable by humans (i.e., the participants of the meeting). Therefore, analysis and subsequent generation of logs into more relevant documents occurs. Such documents are used within meeting discussion, thus enhancing such discussion. These documents are called *derivatives* and are generated dynamically ('on-the-fly') by Logan. The derivatives are viewed as Web pages in Logan (and therefore are generated as HTML). One type of derivative generated by Logan is the *verbatim minutes*. The verbatim minutes present a tidied-up version of the log marking up meeting discussion with:

1. an Agenda index composed of agenda item names and numbers, and startup and windup phase entries
2. headings for agenda items and startup and windup phases
3. linking from the Agenda index to the headings in 2
4. re-organisation and linking of remark information

For reasons of space, derivatives cannot be covered in detail here but may be referred to in [Raikundalia and Rees 1995].

Such a verbatim minutes derivative is shown in [Fig. 3] in the top, left-hand component of the Figure. The verbatim minutes allow high navigation of log information with extra details such as agenda items. As a result, the verbatim minutes are relevant in picking up discussion easily, in knowing where discussion occurs during a meeting and in navigating to different parts of log information. Thus, the verbatim minutes are useful in applying in creating meeting minutes. However, other derivatives are generated by Logan for different purposes and may be generated and viewed from the *Derivative index* at the bottom of the verbatim minutes.

Logan Minutes

The minutes of the meeting are developed by the secretarius. A minute is a set of details associated with a single agenda item. To develop a minute, Logan supplies:

1. verbatim minutes—for navigable analysis of discussion
2. summary points of discussion items
3. fill-in forms—one for each minute

Like traditional minutes, Logan minutes support the following concepts for each minute:

- outcome—the result of discussing the item
- decisions—what was decided (and is carried out) from discussion of the item
- actions—tasks to be performed by group members in relation to the item, that together form an action list

1 Apologies

Outcomes Tim Mansfield was absent.

2 New agenda items

Outcomes Michael contributes item #5, "A personal view of DSTC2".
Ken contributes item #7, "What role will units play in DSTC2?".

3 Matters arising from minutes of last meeting

Outcomes Michael offers suggestions about navigation bar regarding text.
He gives a similar suggestion about images in the index of Logan Central.

Decision Make changes to images in navigation bar and Logan Central index.

Action Apply Michael's suggestions.

Participant Gitesh Raikundalia Due date 1/1/97

4 Participant agenda contributions page

Outcomes Ken claims the page is cleaner. He points out issues regarding change of detail in a contributed item and item initiation.
Peter suggest improvements to the interface regarding columns and fields for document details.

Decision Make changes to participant agenda contributions page.

Action Apply suggestions.

Participant Gitesh Raikundalia Due date 1/1/97

5 A personal view of DSTC2

Outcomes Michael points out that DSTC2 is 2 years away.
Gitesh suggest incorporation of more sites conducting Distributed Systems research whereas Ashley suggests tight focus be maintained.
Michael indicates that organisations in Sydney and Melbourne be considered and that an international reputation is needed. He speculates about a project–based form of research.
Peter reminds us of overall coordination required to which Michael indicates a research coordinator will be needed. Michael indicates new resources needed, eg video walls. He also mentions more appropriate strategy of streams than units.

Figure 2: Logan minutes

After discussing an item, the outcome of discussion is known and a set of decisions and actions (upon which participants will act) may be recorded. For an action there is an associated participant and date by which the action is to be completed by the participant. From experimental meetings conducted with Logan, it was found that three decisions, each with an action, were more than sufficient for recording a minute.

Logan employs a generally agreed (universally recognised) format of minutes. A meeting commences with an announcement of group members not in attendance ('Apologies'). Apologies are followed by the opportunity for participants to suggest new items for the agenda. Then the minutes of the previous meeting are viewed with opportunity to question or disagree that the minutes a correct record of that meeting. During this review of the minutes, the secretarius will report actions from the last meeting (action status). The final item, 'Other business', is always included for other miscellaneous matters to be raised and discussed. Thus the first three items in a meeting are:

1. Apologies
2. New agenda items
3. Matters arising from the minutes of the last meeting (absent in the first meeting in a chain)

and the last item (the n^{th} item) is:

n. Other business

An example of a Logan minutes page is displayed in [Fig. 2]. The format of a minute is the following, going from the top of the page to the bottom: item number and name; outcomes; decision; action for this decision; and the participant and due date for this action.

The last three of these features are repeated in the given order for each further decision. A minute is interpreted in the following way. For any given item, there are associated outcomes of discussion. A decision made may or may not have a following action. If there is an action, beneath the action is the participant assigned the action and the

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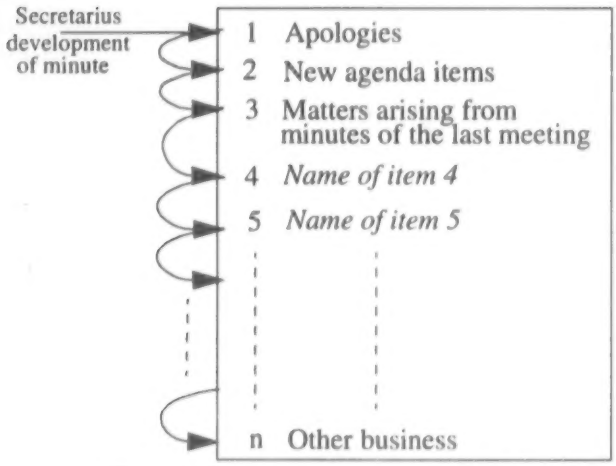
Secretarius development of minute
1 Apologies
2 New agenda items
3 Matters arising from minutes of the last meeting
4 Name of item 4
5 Name of item 5
n Other business

Figure 3: Logan support of item-by-item minute development

date for completion is shown next to the participant's name. An example of this format is item 3 of [Fig. 2], 'Matters arising from minutes of last meeting'. An outcome of three lines is shown. Beneath the outcome is a decision expressing that certain changes to images are to be carried out. The action associated with this decision is to 'Apply Michael's suggestions'. The participant carrying out the action, Gitesh Raikundalia, is indicated in the next row. The date by which this action should be carried out is in the same row as the participant name—'Due date: 1/7/97'.

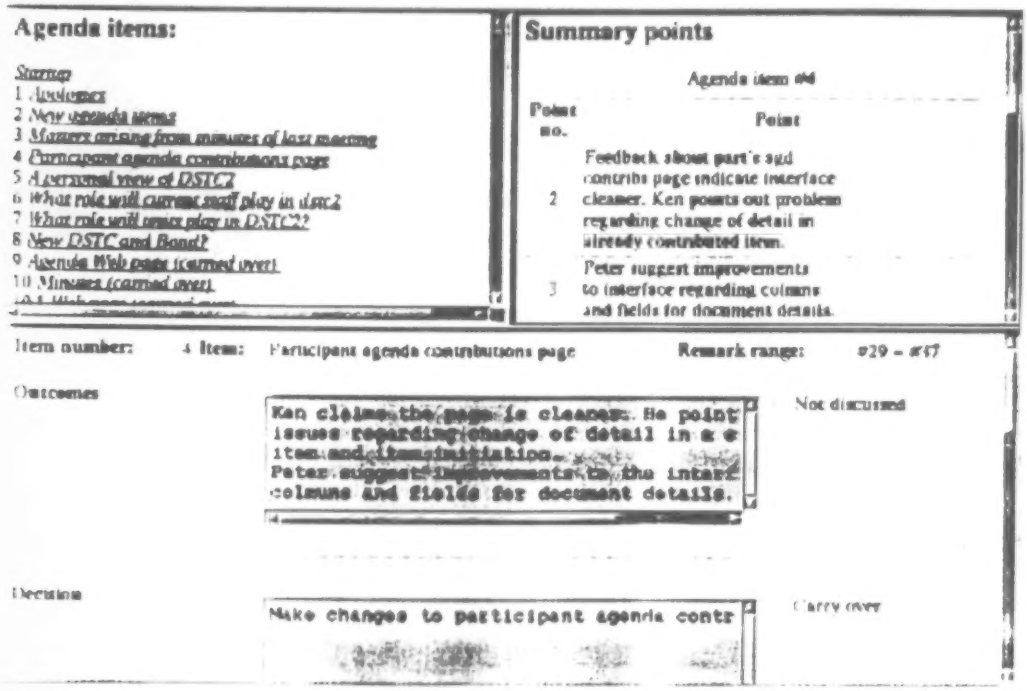
Agenda items:
Summary points
Agenda item #4
Point no.
Point
2
Feedback about part's agd contribs page indicate interface cleaner. Ken points out problem regarding change of detail in already contributed item.
3
Peter suggest improvements to interface regarding columns and fields for document details.
Item number:
4 Item:
Participant agenda contributions page
Remark range:
#29 - #47
Outcomes
Ken claims the page is cleaner. He point issues regarding change of detail in a c item and immediate
Peter suggest improvements to the interf columns and fields for document details.
Not discussed
Decisions
Make changes to participant agenda contr
Carry over

Figure 4: Minutes creation tool

For reasons of flexibility, a decision may have no associated action (and therefore no associated participant or due date). Where a decision was not made, no decision is recorded, thereby avoiding unnecessary use of vertical whitespace in the minutes page. Consistent with conventional meetings, an item can be *carried over*. That is, because the item was not discussed eventually during the meeting, the item is included as an item in the agenda of the following meeting. In this case, the outcome becomes 'Not discussed' as indicated by the secretarius.

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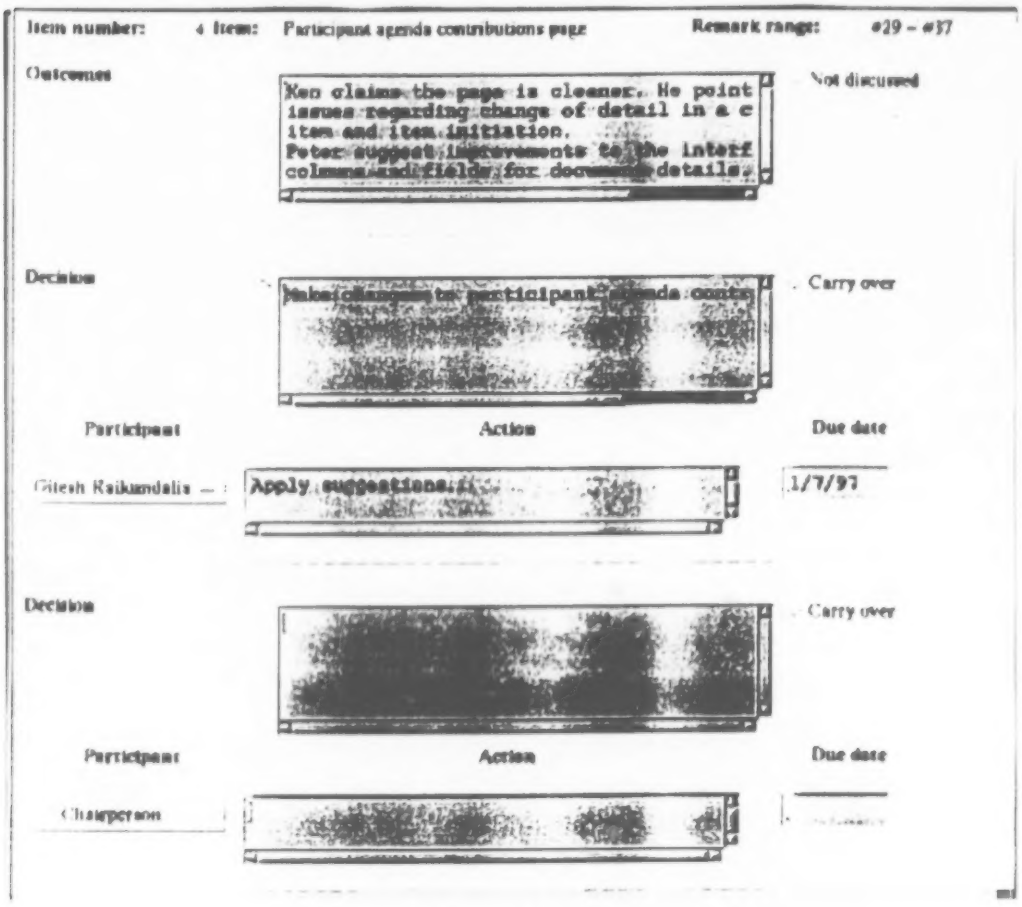

Figure 5: Minute creation form

Because of the association between decision, action, participant and due date, these attributes have been kept adjacent to one another. Otherwise, it is very difficult for the user to see the collective significance of these attributes. This adjacency is achieved using a two-column format, with the minute attribute (e.g., Item, Outcomes, etc.) and its recorded detail side-by-side in the same row. A row with a new item number and name has a yellow coloured background (seen as a thin, grey strip in [Fig. 2]) to indicate visually the commencement of a new minute.

Minutes Development

Item-by-item minutes creation occurs as in [Fig. 3]. *Apologies* and *New agenda items* rarely require decisions and actions. Fill-in forms are provided for each item (that is, each minute). Once details for a minute are entered, the information is submitted using a 'Submit minute' button. Subsequently, a new form is loaded, specifically designed for the next item in the agenda. Details for the next minute are then provided in the same manner. This process continues until forms for all minutes are completed and the secretarius arrives at the end of the discussion items.

Automation of minutes creation by the secretarius is achieved using the *Minutes creation tool* shown in [Fig. 4]. The top row consists of a frame containing the verbatim minutes on the left and a frame containing the summary points on the right. The bottom frame contains a form, the *Minute creation form*, for which details for one item are submitted (partially shown). The Minute creation form is shown expanded in [Fig. 5]. Verbatim minutes and summary points assist the secretarius in determining the details filled in the minute creation form.

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The secretarius will scroll the verbatim minutes while reviewing discussion. The verbatim minutes are navigated, and relevant remarks are considered in determining the details of a minute. The summary points, which were developed during the meeting, are a convenient guide also used for determining minute details. In fact, the points are re-usable in that text may be copied-and-pasted from the points into text fields of the Minute creation form. The points provide some details of outcome, decisions and actions, but even when put together are not complete in as minutes. Therefore, the secretarius can add additional details easily to summary point details in creating the minute.

At the top of the Minute creation form in [Fig. 5] is the range of remarks over which discussion of the item occurred ('#29 – # 37') as found in the verbatim minutes. Using this remark range, the secretarius knows where to view discussion about the item in the verbatim minutes. Below in the *Outcomes* section, the secretarius chooses either to fill in details regarding the outcomes of discussion or indicate that the item was not actually discussed ('Not discussed'). In the *Decision* section, the secretarius either chooses to provide details about a decision or indicate that the decision is to carry over the item to the following meeting (denoted by 'Carry over'). Underneath the Decision section are form elements for providing action details. The secretarius has the flexibility to enter the date in any format desired (e.g., 'day/month/year' or 'day month year').

In the remainder of the page, there are two more decision-action sections as well as buttons for submission and resetting of the minute creation form (not shown in the Figure). Logan writes content for a minute page based only on fields that are checked or have text entered into them. Thus, a 'Due date' text field for which no value is entered will mean no corresponding date label or data is presented in the minutes page.

Once a minute is submitted, Logan will append the details of the minute to the current version of the minutes. A fresh Minute creation form designed for the next minute (with item number, name and remark range information) is loaded. After the form for the final item in the agenda is submitted, the final minutes are displayed with a 'Send minutes email' button. The secretarius is able to view the final minutes before emailing them to participants.

Conclusion

An item-by-item, Web-based technique for development of electronic meeting minutes was presented. The secretarius is assisted in compiling the minutes through application of verbatim minutes and summary points. The secretarius uses analysed meeting discussion to review the discussion for each item. Using summary points for an item, the secretarius pastes any part or all of a summary point into the appropriate text field using a review of the discussion to add to the content of the text field. Other details are specified through selection of information, for instance, participant names in a popup menu.

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Acknowledgements

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Guiding and Directing a Meeting with Logan

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Abstract: For a formal, computer-supported meeting to yield productive discussion and achieve its goal effectively, the meeting should be directed with its content reasonably pre-determined using a powerful tool. This research describes such a tool, *Logan*, used to provide *meeting guide* functionality. Meeting guides support display of instructions for the *officials* (the chairperson and secretarius) of the meeting, reminders for participants, agenda support points for promoting and guiding discussion, and summary points for meeting review. Logan provides two different guides specifically for each official.

Introduction

A formal meeting must be productive in yielding useful outcomes and in achieving the meeting goal. To enable such productivity and achievement, the meeting must be directed effectively and appropriately by the chairperson. The meeting is conducted using time effectively, minimising off-the-topic discussion, allowing all participants ample opportunity to contribute to discussion, and so forth. Such a meeting is driven by an agenda containing items for discussion. Discussion must cover as much as possible of the issues relevant to the agenda.

Logan is a *Web Electronic Meeting Document Manager* (WEMDM). A WEMDM handles a range of document issues such as the creation and application of an agenda. The WEMDM is used in tandem with a discussion tool which is used to display and capture verbatim remarks. Logan provides functionality for meeting guidance and direction. A meeting supported by Logan involves both the roles of chairperson (the chairperson role in a traditional, face-to-face meeting) and a *secretarius*, who is a participant responsible for administrative meeting tasks like minutes creation. These participants together are referred to as the *officials* of the group of participants.

Logan provides both a *chairperson meeting guide* (CMG) and a *secretarius meeting guide* (SMG). The CMG assists the chairperson to direct the meeting allowing the chairperson to organise and structure the discussion for the meeting. The CMG is used by the chairperson to aid in coverage of agenda items (issues for discussion) by stimulating discussion of these items. The SMG allows the secretarius to think about and include further points for discussion regarding these items. Inclusion of the secretarius' points allows the group to consider more ideas during discussion and provides another viewpoint on an item. Each guide is a Web page used to both view information and update the information found on the same page. These pages are generated by Common Gateway Interface scripts that provide for dynamic update of information.

Guides are used to:

- instruct the officials of the various duties of the meeting that they must carry out, and when these duties may occur during the meeting
- create and view supporting points for the agenda
- create and view reminder points for reminding participants of any relevant meeting-related details (e.g. advice in using the WEMDM or the discussion tool, reminding participants of negotiation of the next meeting time at the end of the current meeting, etc.)

- create and view summary points for review at the end of the meeting and assist in minutes creation

Agenda Support Points

For organising discussion by the chairperson and allowing further support points for discussion for the secretarius, the officials are provided with *agenda support point* creation. Each official will use his/her own guide to view the agenda items and create support points for them. Examples of agenda items with support points created by the chairperson are shown in [Tab. 1]. The chairperson can base expanded discussion of the corresponding items on these points. Similarly, the secretarius also creates points, further expanding discussion.

These points are also useful in saving time and providing convenience for the officials in discussion. Rather than type out the remarks in the discussion tool, the points can be created before the meeting, copied-and-pasted and entered into the discussion tool during discussion. Also, such support points allow personal notes for the officials. For instance, the secretarius could record how adequate s/he believed the coverage of an item was.

In the SMG, there is additional support for summary point creation and viewing. The secretarius uses this support to summarise items with summary points that are copied-and-pasted and entered into the discussion tool for meeting review. Summary points for an item are created by the secretarius during the item's discussion. These points are also highly useful in compiling outcomes in meeting minutes.

Agenda item no.	Agenda item	Support point no.	Support point
1	Research direction	1	Research interests: Soft. Eng., AI and WWW.
2.2	Research funding	5	Government support?

Table 1: Agenda items with corresponding support points

Meeting Guides

The CMG is composed of various sections providing functionality for chairperson use. These sections with their corresponding user interface elements are (in order of placement going from the top of the guide to the bottom):

- instructions of tasks and duties—table
- agenda support point creation—fill-in form using table, radio button selection and a text field
- agenda support point viewing—tables

The above sections are also provided in the SMG. In addition to these sections, the SMG also contains:

- reminder viewing—tables
- reminder creation—fill-in form using popup menus, radio button selection and a text field
- summary point viewing—tables
- summary point creation—uses the same form in agenda support point creation but with a check button for indicating that the point is a summary point

New items may have been accepted into the agenda since the time the guide was last used. Thus, the current version of the guide is updated with tables for these new items and for their support points. Another situation occurs where there are items carried over from the previous meeting. These carried over items will have associated agenda support points. Therefore, Logan automatically carries over the support points and updates each guide.

Acknowledgements

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MULTIPLE USES OF THE INTERNET IN THE UNDERGRADUATE BIOLOGY CLASSROOM.

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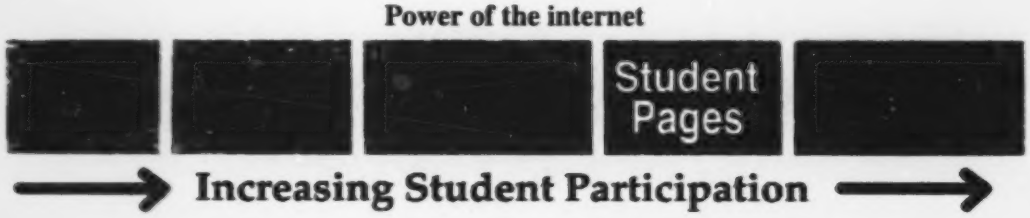
Abstract:
The internet can be used in a variety of ways at different levels from gathering information, real life application, Email, creating web pages and performing real time experiments. Students from universities, community colleges and K-12 schools have access to conduct Noble-prize winning state-of-the-art microscopes via the World Wide Web. Lesson modules have been developed geared towards the curriculum. In essence it is creating a laboratory without walls. This technology uses the power of the internet to level the playing field by providing access to research grade instruments which is at present only available in a few universities. This is an ideal medium to promote student scientist partnership so that everyone can participate in scientific research. An actual real time experiment will be performed via the World Wide Web at the AACE conference using state of the art equipment from Arizona State University.

Introduction

Imagine scientific research being conducted beyond the walls of a traditional laboratory, research that can be donein an undergraduate classroom in a university or community college. Imagine students in K-12 classrooms observing these experiments or even imagine observing it being done in your own living room.

Such synergistic collaborations is possible with the recent development of the world wide web as a practical
affordable tool for linking universities, colleges, schools, museums, in short anyone with a computer on a network. The different ways in which the teachers and students can exploit the internet for developing new education paradigms is analyzed in this paper. Students at Chandler Gilbert Community College use the world wide web in a variety of ways.



Info: Traditionally the world wide web has been used as a source of information. Even the most computer-phobic student can learn to use the world wide web within an hour. There is a barrage of information on the web but by the same token, there is also a lot of misinformation. The development of students critical thinking judgment can be facilitated by the teacher.

Real world: Students of Biology at Chandler Gilbert Community College work on service learning projects, do numerous application level learning pertaining to the real world. They use the world wide web to both access information and at the same time use the web as a media to present their work.

Communication: The internet is a wonderful vehicle through which students can communicate with the instructor and also with other students of the class. Students have access to the instructor at all times and are just not restricted to the "traditional office hours". This is a great bonus for community college students, the majority of whom work, have families to care for and are full time students.
Student pages: Creating web pages on the world wide web is also a great tool for increasing student participation. Students write research papers, reflection papers, short critiques, etc. for a class, then they choose their best work to create a "webfolio" and publish it on the world wide web. Since students are writing to a much bigger audience, they are much more inclined to produce better quality work.

Remote experiments: The ultimate activity on the web with the maximum student participation is by performing as well as observing experiments remotely via the world wide web. United States is a world leader in science and technology, but we are still striving to percolate the excellence at research frontiers into K-16 classrooms. We need to bring the excitement from the frontiers of scientific research into the classroom. This has been achieved by a NSF project called Interactive Nano Visualization for Science and Engineering Education (INVSEE). INVSEE has created an Arizona State University led consortium of university and industry scientists, community college and high school faculty and museum educators with a common vision of building an interactive www site for nanoscience and technology. The State-of-the-art instrumentation Nobel-prize-winning scanning probe microscope has been put on the world wide web. The partners of the INVSEE project are Arizona State University, Chandler-Gilbert Community College,Arizona Science Center, Motorola, and Topometrix. The web address of the INVSEE home page is http://invsee.asu.edu.

Students and faculty from universities, colleges and high schools can get actively involved in real time research in ways that are unimaginable before the advent of the internet. Experiments that were previously only described in scientific journals and textbooks can become a part of everyday science and engineering education. INVSEE empowers students and teachers with novel learning technologies that will let them visualize and understand our material world at the invisible atomic and molecular scale.

INVSEE is an unique initiative that enables a science or engineering class ('operator') to select and investigate materials over the world wide web. Using a 'fishbowl' format, other classes ('observers') will be able to observe the operator class conducting an experiment.The world wide web allows one to use technology truly as a transportation tool. A valuable collaborative environment can be created via the world wide web. To help meet this goal interactive multimedia, internet accessible educational modules are being developed to complement the real time, remote scanning probe microscope's visual learning technology.
The lesson module "The Five Kingdoms" explains the different characteristics from organisms of the different kingdoms (2). The lesson module on osmosis has been applied across disciplines from Biology to Chemistry and stresses on scientific methodology and process skills (3).

Conclusion: The internet has been a great tool to bring together students with diverse backgound through the many different ways in which it can be used. These interactive modules provide the necessary background and framework to empower students to do real scientific work. This technology gives a new meaning to hands on interactive experience by providing the same remotely via the www (remote hands on). INVSEE will address the need for developing appropriate interactive educational modules that integrate concepts across size, scale, disciplines to emphasize structure-property and structure-function correlation. Future goals for this project include developing a number of lesson modules and more opportunities for K-16 schools to utilize the web for research based experimentation.

Aknowledgements: INVSEE is a National Science Foundation grant (NSF//REC9632740) awarded to Arizona State University with subcontracts to Chandler-Gilbert Community College and the Arizona Science Center. Acknowledgements also to James Archer and Cecilia Hernandez for all their help.

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MODEL OF COORDINATION OF MULTI - AGENT SYSTEMS APPLIED TO WHO ACCOMPLISH LABOR OF AUDITORY OF SYSTEMS OF AN ORGANIZATION

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Summary
In this article is applied the Yubarta model (based on Multi - Agent Systems) [Ucr96] to carry out the coordination process in the distribution of the Information that flows between Auditory and the functional areas of the systems department of an organization, in order to avoid replication, loss or delays in the delivery of the same. So much Auditory as each one of the areas and sub-areas functional are represented as an agent with knowledge, functionality, own communication. It is outlined the application of a coordination model of the agents involved in labor of Auditory effected in the areas and sub-areas functional. Furthermore, it is explained how it should be to effect the administrative process to the interior of the same.

Key Words
Coordination, Multi - Agent Systems , PGP, GPGP, Cooperative Work, YUBARTA, Auditory

Introduction
The coordination is the process of handling interdependencies between activities. For this, several agents should base the communications on the detection and response to relationships of existing coordination between joint of known tasks. It is discussed how the agents can generate communicative tasks in benefit of the coordination, until what point can be guaranteed in the inferences of the receivers to execute these tasks, and how be in favor of the plans and communications to carry out concurrent executions using PGP and GPGP [Les95] [Car96], that they are joint of coordination mechanisms dominance - independent that employ restrictions to divide a local planner in modules. These restrictions assign to him importance to certain tasks due to the fact that contribute to the fact that tasks not - local will be effected and to the fact that its initiation times and finalization they will be appropriate.

Due to information exchange between the Systems Department and that of Auditory, it is necessary to coordinate it, since upon intervening several persons in the accomplishment of various tasks can be presented inconsistencies and work duplication, between other problems.

Furthermore, as some projects depend on the results on others, it can deal the Auditory as a Cooperative Work process. It is wanted to show of what way can be modeled labor on Systems Auditory in an Organization as a Multi -Agent System (MAS) [Lan94]. The auditing consists of effecting the administrative process in each one of the areas of the Systems Department that we will call areas and functional sub-areas, depending on the internal structure on the company. Each one for the responsible of the auditing will be considered as an agent that needs information of others, especially of who coordinates it and to who he coordinates, to execute its tasks.

One of labors costliest in an organization, due to the fact that exist few computational applications that collaborate in its accomplishment, it is the Systems Auditory that consists of the evaluation of the system of computer internal control of the systems of operation. It is taken as auditable object the cycle of the processing of the data (system where reside the objects that they should be protected). At present it has been given to him an operational approach to this field applying for the auditing parameters as profitability, efficiency and efficiency. This auditing is accomplished through the examination and evaluation of the administrative process constituted by five phases: planning, managing, organization, integration and control. Said process is applied to the data processing area, in which the data of the systematized areas constitute simply an element of the auditable object , and to its operations together to its relationship to the components of the organization, as a rule, without losing of sight the objectives and mission of the organization [Car97b].

For the modeling so much of the coordination system as for the application of Auditory was used YUBARTA, that more than a model is a tool for modeling and cooperative systems specification; offer an abstract representation mechanism of groups of work (the model), as well as a formal language to specify the dynamics of the represented system [Ucr96].

The principal characteristic of YUBARTA, is that at level of modeling and specification, encompasses the different aspects of the work mechanism in group, as are: communication, coordination, cooperation, knowledge of each one of the integrating and of the group, negotiation, etc. For this, they have been taken as theoretical basis of the model the Multi - Agent Systems (MAS) [Kle95], that consist of modular systems of distributed computation and permit to represent computationally the real dynamics of the groups of work for the flexible tools construction that give support to said groups [Rue96]. As far as he/she is concerned, the Yubarta language allows specifying the knowledge and functionality of each agent of the system, as well as how them interact mutually. With this language is possible also, to model partial or total states of the system, the changes that suffer these states, as well as the actions that make possible these changes. Furthermore it can be expressed if the actions are executed of sequential or concurrent way. [Her 96] To apply the Coordination model was necessary to widen the architecture of the agent of the Yubarta model as is explained in this article and more in detail in [Car97]. Furthermore it was made a new coordination version applied to labor of Systems Auditory of an organization, especially for who carry out the administrative process in each one of the areas and sub-areas functional of the Systems Department [Car97].

In the first part of the article is described briefly of what consists the model of Systems Coordination Multi - Agents, then, the Systems Auditory, especially, the administrative process. After, it will be described informally the Multi - Agent Systems of who audits. To end, it is presented the current work, the work future and the conclusions of this work.

Conclusions

For the Coordination model that was added to Yubarta was necessary to widen the structure of the agents. They were introduced mechanisms of control as part of its knowledge, functionality, communications involved between other. Said model was applied to one of the functions of the organization that more was needing coordination since the success in labor depends on what so coordinates will be the tasks than there are accomplished.

The coordination process of an organization is quite complex. Not only it should be to think at level of the functional areas, but also of the processes that are carried out to the interior of the same. Is worth the trouble to mention that to facilitate labor of coordination, it is better to carry it to end at several levels as was explained in this article.

To model the information managing between Auditory and the areas auditable of the systems department was chosen the model YUBARTA, since the coordination process that is accomplished between the agents permits to consider all the tasks to accomplish to distribute them cohesively between all they, taking into account time restrictions, cost, dynamical means, etc.
Furthermore permits to coordinate the tasks for: not to duplicate work between the agents of the systems, not to have overburdened work agents and, cause that the sub-plans of the agents will be compatible.
It was specified the Multi - Agent System with the YUBARTA Language, and we see as can be applied the Yubarta model to the problem of Information Managing and the different coordination levels that they are necessary so that the tasks of Auditory will be carried out and how they should be distributed between each one of the areas auditable of Systems.

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Integrating Alternative Media into Curriculum: A Case Study in Freshman Biology

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Abstract: The growing availability of the internet to the student body offers an additional means of communication between student and instructor. However, as with other types of communication, the instructor must be mindful of the internet's weakness as a means of information delivery and make efforts to minimize. We have attempted to minimize the effectiveness of various media forms while minimizing their weakness in designing a web-based course in introductory biology.

Outside the lecture hall, three forms of media are readily available to provide students access to curriculum content; print, computer disk, and internet. Each of these media forms has strengths and weakness for use in instruction, from the standpoint of both the instructor's use as well as the student's use. The intent of the curriculum we have designed is to integrate these three media forms into as effective a course as possible.

Print media, which includes traditional textbooks as well as any paper handouts one might generate, has familiarity and ease of mind as its primary strength. While freshman college students may be dismayed by the size of a text or may not be able to use the book as efficiently as possible, it is a means of communication which all are familiar with and able to use without instruction. It is easily transportable and works when the power is out or not available. It can be stored without direct cost for long periods of time. The disadvantage of print material lies primarily in its development and production costs and the time delay between its printing and its use by the consumer. Print is also a static form of media.

Media delivered on computer disk, specifically CD ROM, has as strengths the ability to impart a reasonably large amount of information in a dynamic fashion. Student users may be asked to manipulate items or make responses before proceeding to additional areas, requiring greater interactivity in the learning process. CDs may also be more readily updated and less expensive to produce than some forms of print media. The drawbacks to disk media are that it requires students to have access to the appropriate computer hardware and that students need to have or to learn a degree of competency with computer use and to learn to use the program's interface. Similar to print media, there is some time delay between the production of the computer program and its use which could result in imparting dated information.

The internet's major strengths are its speed by which information can be updated and the ability to reach out to access information worldwide. On the downside, use of the internet requires that students have the hardware to be connected. Even if connected, the type of hardware may limit the practicality of some types of information being delivered over the internet. Further, the information may not always be accessible due to down time by the hosting institution. Additionally, for many students the internet creates a high degree of anxiety which interferes with their learning process.

The biology course we've designed attempts to deliver a course which maximizes the strengths of these three media forms. A traditional textbook is utilized giving students the comfort of this familiar learning paradigm. We have developed a CD product which serves as 'lab' component for the course, rich with imagery and interactive exercises. The web is utilized to communicate the more dynamic elements of the course such as weekly assignments, lecture notes, grades, student's questions as well as linking students to additional topical web sites. Through the use of these three media forms we believe we've created course which is accessible to the students and a viable complement or alternative to the traditional lecture/lab format for the instructor.

A Customizable Shorthand System for Hypertext Authoring

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Abstract: The growth of the World-Wide Web has lead to a profusion of web pages and tools for constructing such pages. At present, most tools fall into one of three categories: (1) *enhanced text-editors* that provide commands for including and checking HTML; (2) *translators* that allow authors to develop pages in the format of their choice (e.g., Microsoft Word, LaTeX) and then convert from that format to HTML; (3) *visual editors* that allow authors to build pages visually, rather than textually.

In this paper, we describe an alternate model for web construction, **SW/Shorthand**, a *flexible* and *programmable* translation system that supports the quick and easy construction and formatting of text-oriented web pages while allowing web authors to write as little or as much HTML as they prefer. SW/Shorthand supports a wide variety of operations, from automatically tagging paragraphs and lists to context-dependent translation. Importantly, SW/Shorthand is *customizable* so that it meets the preferences and needs of different authors.

1. Introduction

The World-Wide Web [Berners-Lee et al. 1994] has revolutionized computing and brought hypertext from the realms of academia to virtually every computer user. It has become a distribution medium for a wide variety of content, from course handouts to sports scores, from virtual museums to online games, from professional magazines to amateur 'zines. As the web has grown, so have the tools used to create individual pages.

While authors originally had to write "raw HTML", these new tools have simplified construction. At present, there are three primary types of tools for building web pages.

- *Enhanced text-editors* provide commands for including and checking HTML. When using one of these editors, an author selects text to annotate and a type of tag and the editor inserts the appropriate tags. BBEdit is an example of this type of editor.
- *Translators* convert files from an existing format (e.g., Microsoft Word, RTF, or LaTeX) to HTML. These translators allow authors to develop pages in the format of their choice. Examples of translators include latex2html [Drakos 1995] and Microsoft's "Export as HTML" command.
- *Visual page editors* permit authors to build pages visually, rather than textually. When using visual editors, authors select text and appearance (in effect, the tags) and the editors fill in the appropriate tags "behind the scenes". Example of visual page editors are Microsoft FrontPage and Adobe PageMill.

Such tools have many strengths. They are particularly useful ensuring that pages are syntactically correct. They have also permitted many novices to author pages without being deterred by the apparent complexity of HTML. (This is, of course, a false complexity. Most prospective authors can learn to write HTML in an afternoon.)

At the same time these tools have some weaknesses. Many tools provide or use only a limited set of HTML commands. This limitation becomes most apparent in the often lengthy period between the time HTML is extended and the time a corresponding version of the tool appears. More importantly, such tools tend to focus on visual format rather than on logical format. All too often, the pages generated by these tools (particularly by the visual editors) only "look right" on the machine and window size for which they were designed. Many of the translators also tend to emphasize the appearance of the original text rather than the roles of the subtexts. Because the tools (of all types) do not easily support logical design, they tend to rely on logical tags

for physical effects (e.g., using a header tag simply for larger text). Because these tools create large amounts of HTML, it is often to go back and manually edit.

For more advanced users, there are many benefits to authoring directly in HTML. An author who writes "raw HTML" can use new tags as soon as they are available (and even before they are available, since most browsers ignore tags they don't understand), ensure that documents are formatted logically, and include links conveniently.

An author who writes "raw HTML" also faces many disadvantages. Just as it is easy to get "lost in hypertext" [Nielsen 1995], it is also easy to get "lost in HTML". Often, authors forget to match tags. It is sometimes inconvenient to remember to insert all of the appropriate tags. The logical design of a page doesn't always match the physical appearance. It is sometimes difficult to update the layout of a page generated with raw HTML. One difficulty of writing raw HTML is illustrated by the common mistake of forgetting to close `<UL>` and `<BLOCKQUOTE>` tags. Many pages with lists or quotations end with an inappropriate level of indentation and authors do not readily notice such problems.

What such authors need is a tool that allows them to write "just enough HTML" and that fills in the rest (such as the aforementioned closing tags). Since different authors will have different notions of "just enough" and "the rest", such a tool should be flexible enough to allow authors and groups to customize it according to their needs. At the same time, in order to ensure that the tool is small and quick, it should not attempt to be all things for all authors. Rather, it should fit into a larger collection of tools which provide additional facilities.

In this paper, we describe such a tool, **SW/Shorthand**, a programmable HTML shorthand system that is part of **SiteWeaver**, a suite of tools for site development. In ["Quick and Dirty" Authoring] we describe the technique of page development which SW/Shorthand is designed to support. In [A Model for a Shorthand System] we describe the rules authors and designers write in developing custom shorthands. [Limitations and Alternate Technologies] we report on some of the shortcomings of SW/Shorthand and relate it to other tools for web authoring.

2. "Quick and Dirty" Authoring

The wide variety of uses of the web suggest that there are a number of ways in which authors build (or would like to build) pages for the web. Large, graphics-rich, pages (such as those often used by larger commercial sites) will necessarily require care in design and editing. However, many authors are more concerned with their textual content and presenting it logically and informatively. These smaller, text-based pages should be easy to create and maintain. We will focus on these smaller, more text-oriented pages.

Maintenance is further supported by the growing number of site-level authoring systems, such as ASML [Owen & Makedon 1998], Gentler/Siteview [Thimbleby 1997a; Thimbleby 1997b], HyperG/HyperWave [Maurer 1996], and WebCT [Goldberg 1998]. While these tools provide a rich suite of site-level capabilities, from automatic linking to online quizzes, many expect to have content created in HTML or a subset of HTML and then provide additional features.

How do authors commonly build the smaller pages that make up the bulk of pages on the web? Often, they begin with an existing text (such as a memo, letter, or paper) and manually (or automatically) convert it to hypertext. Many follow a similar procedure when creating new pages: they write the text and then worry about the conversion to hypertext. For a large group of authors content development and hypertext design are quite different activities and need to be separated during creation, editing, and maintenance.

What does it mean to "convert a text to web-based hypertext"? As with many issues in hypertext authoring, it depends on the author. Most will agree that such conversion includes (1) *markup*: insertion of HTML tags that provide structure and enhance appearance; and (2) *linking*: insertion of links to and from related documents.

The insertion of tags can be a particularly tedious and repetitious process, with the author being required to identify the roles each piece of text plays and insert tags around each piece. If a piece of text is misidentified or a tag mistyped, the author may need to spend significant time "debugging" the markup.

Often, authors realize the roles that pieces of texts play while they are writing, but find it inconvenient to insert HTML tags while they write. Many naturally employ some form of shorthand to remind themselves of these roles for the later markup stage. Typical shorthands include blank lines between paragraphs, indented quotations, tabbed tables, and starred list items. For example, one might write the text in [Fig. 1] as a shorthand for the document [Fig. 2]

```
** Building a hypertext **

There are a number of tasks that are involved in building a hypertext.
They include
* Content creation
  + Text
  + Images
  + Other media
* Markup and annotation
* Linking

Because of these different tasks, the creation of a serious hypertext
often requires a number of different contributors who play many roles.
In some projects, the assignment of tasks to role are as follows:

        Role    |Content| Media | Markup | Linking
        Author  |   X   |       |        |   X
        Designer|       |       |    X   |   X
        Artist  |       |   X   |        |
```

Figure 1: Shorthand for a hypertext document.

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Role	Content	Media	Markup	Linking
Author	X			X
Designer			X	X
Artist		X		

Figure 2: The formatted hypertext document described in [Fig. 1].

In this example, the author has used

- blank lines to indicate the beginning and end of paragraphs;
- asterisks at the beginning of lines to indicate level-one list items;
- plus signs at the beginning of a lines to indicate level-two list items;
- tabs and vertical bars to indicate the boundaries of a table.

Note that most of what the author has indicated is logical, rather than visual. The author has chosen how to present material, using lists, tables, and quotations as appropriate. It would then be up to the designer to

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determine specifics. These specifics might include not only font, but also how to present tables (e.g., with or without rules), what other components to include on the page, and other related details.

Such shorthand can simplify the process of markup and can also permit separate people to play the roles of author and "marker". At the same time, such a separate of roles can make update difficult. If authors want to make changes, should they be able to change the original text or the marked text? Most authors will find it easier to modify the original text, but "markers" will find it preferable that authors modify the marked text.

A system that automates the translation from shorthand to HTML will improve this process. Using such a system, authors can continue to write in the shorthand they find most appropriate and designers and markers can specify how the shorthand corresponds to actual markup. Because there are many authoring tasks (e.g., building tables of contents, spell-checking, copying "attributes" of one page (e.g., the title) to another page, linking, and gardening) that cannot be represented by such a system, the shorthand system should provide just one piece in a larger page and site design system.

3. A Model for a Shorthand System

We envision a tool which simplifies the authoring and maintenance of text-oriented webs and web pages. SW/Shorthand provides a simple yet powerful model for describing the relationship between the shorthand notations authors use and the corresponding HTML markup that is intended. The design of this model is based on a number of interviews with authors and on experience developing a number of sites (both academic and commercial) using a simplified shorthand system.

A *rule* in SW/Shorthand consists of four components:

- A textual *input pattern* to match. Patterns are standard regular expressions that include alternation, concatenation, repetition, and limited negation.
- A possibly empty *context* which limits translation to instances in which unclosed tags appear (or do not appear) previously. The context permits patterns to apply only in restricted circumstances. For example, a blank line signals the end of a paragraph only when an unclosed paragraph tag appears on the stack.
- A collection of *actions* to perform when a piece of text matches the input and stack patterns. Typically, the actions insert or transform text, but they may also provide additional functionality.
- An optional *precedence* which orders the rules. If no precedence is specified, rules are applied in the order they appear. The use of precedence permits modular collections of rules as well as default rules that can have lower or higher precedence than rules authors and designers add.

[Fig. 3] provides some sample rules written in an English-like syntax. While SW/Shorthand currently uses a much terser syntax, the semantics are independent of the syntax and we do plan to support a more verbose and readable syntax in the near future.

```
When you are within a section of preformatted text
  skip any lower precedence rules
When you see exactly one * at the beginning of a line
  ensure that there is exactly one unclosed <UL> tag
  insert <LI> at the beginning of the line
  delete the *
When you see a blank line AND are within a paragraph
  close the paragraph and any intervening unclosed tags
When you see a nonblank line AND are not within a paragraph-like section
  insert <P> at the beginning of the line
When you see a tab at the beginning of a line
  ensure that you're in a quotation
```

Figure 3: Sample translation rules.

Obviously, a number of rules can be stated in different ways. For example, the final rule describing quotations might also be described as

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```
When you see a tab at the beginning of a line AND
you are not within a quotation
  begin a quotation
```

Similarly, the level-one list item rule might be stated as a series of rules that add or close <UL> tags.

As the rules suggest, this triplet-based design provides a rich environment for describing translations. The text patterns permit one to describe a variety of shorthands. The stack patterns permit translators to contextualize the translation. The actions support a variety of effects.

What types of actions are available? One may want to

- *Insert new text* before, after, or within a pattern. This may also affect the context as opening begin new blocks or closing tags end them.
- *Delete* part or all of the pattern.
- *Replace* part of the pattern. While some replacement can be simulated by insertion and deletion, it is likely that other forms of replacement will be easier to express with a sed-like expression.
- *Close open tags*. Often, this closing should have an "automatic" effect of closing any intervening tags.
- *Manipulate the context* in more complex ways. For example, it is often useful to require that translation enter a particular context (such a two open <UL>s) and allow SW/Shorthand to determine
- *Control translation*. At times, it is necessary to "turn off" subsequent rules. For example, when within a preformatted section one may not want to translate lists. While this can be simulated by a more complex contextual pattern, it is difficult to ensure that such a pattern is used everywhere.

4. Limitations and Alternate Technologies

While the model provided SW/Shorthand is rich and customizable, it does have some limitations. At the same time, there are also a number of other web technologies that can provide similar utility. In this section, we discuss these limitations and the alternate technologies.

A primary difficulty of SW/Shorthand is that it makes it difficult to express complex markup. Consider the task of including multiple paragraphs within a list item. The typical translation rules (a nonblank link begins a new paragraph; a blank line ends an open paragraph and intervening open tags; a star at the beginning of a line starts a level-one list item) require that when a paragraph end, the list item within it also ends. While it is possible to write a more "robust" set of rules, writing such rules and predicting such instances is much more difficult than writing the typical rules.

A second danger relates to SW/Shorthand's customizability. It is likely that different authors and groups will develop different shorthands. This may make it difficult for one author to update a document created by another author. We are currently investigating methods for translating between shorthands.

In addition, of number of SW/Shorthand's features are becoming supported by other technologies. Cascading Style Sheets (CSS) [Lie & Bos 1996; Lie & Bos 1997] provide one obvious alternative for the separation of design and content creation. XML [Bray et al. 1997] permits a richer markup so that authors can more easily describe the roles of text. While neither supports the types of shorthand we have suggested, it is likely that many authors can modify their styles to accommodate them. However, XML does have the same customizability problem as SW/Shorthand as it is possible for different authors to develop different groups of tags.

One possibility is to join the technologies. That is, use SW/Shorthand as a shorthand for XML rather than HTML. Since XML is also tag-based, it is possible to write SW/Shorthand rules that translate an author's shorthand to XML. While more implicit formatting (e.g., of the parts of a reference) might require more sophisticated rules than are commonly used, such rules should be possible and are a subject of further research.

It should also be noted that some macro systems provide similar capabilities to SW/Shorthand. That is, they allow authors to write abbreviated versions of text and then fill in the rest. However, such systems usually do not directly support the *contextual* translation that SW/Shorthand encourages. More importantly, most macro systems follow a one-time translation model, which makes it difficult for the author to go back and modify the untranslated text.

5. Summary

In spite of the growth of nontextual media, a great deal of web authoring still requires the creation and markup of textual pages. While many tools are available to support this creation, many conflate design and authoring. SW/Shorthand provides a simple and customizable tool that simplifies the creation of textual content which can then be used as input for larger web systems, including Siteweaver, ASML, Gentler/Siteview, HyperG/HyperWave, and WebCT.

By using user-definable rules that include patterns, context, actions, and priority, SW/Shorthand permits authors and designers to develop rich and appropriate shorthands for their own styles or domains. Because it focuses on a single task, it is able to handle a wide variety of instances.

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Issues in Site-Level Web Authoring

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Abstract: In the early days of the World-Wide Web, most sites were small enough and the web was new enough that it was possible to create and maintain sites by hand. However, as the web has grown, so have individual sites and the effort required to maintain sites. Site maintenance may require gardening to prune unneeded pages and links, redesigning pages or groups of pages, and even restructuring the whole site. Too often, effort that should be spent on global design or content issues is spent instead on repetitive details. While page-level authoring tools, such as Adobe PageMill or Claris HomePage, can eliminate some of this tedium, they provide few, if any facilities for managing the many pages that may be associated with a course web.

Fortunately, a number of systems have been developed that support *site-level authoring*, the creation and maintenance of information spaces the contain many related pages. Some of the most feature-rich systems come from the academic arena. These academically-developed systems include ASML (the automated site markup language), CourseWeaver, Gentler/Siteview, HtX, HyperG/HyperWave, I-CARE, Siteview, Siteweaver, WebCT, and WebMapper. Each of these systems provides a number of tools for site developers, designers, and maintainers.

However, each systems presents a different perspective on how to support site level authoring, how to develop sites, and what appropriate tools are for site-level authoring. They include programming languages (ASML), markup languages (Siteview, HtX), compound applications (CourseWeaver, Gentler, I-CARE, WebCT, WebMapper), and hybrids (Siteweaver). This paper surveys the tasks site authors confront and suggests how each system supports those tasks.

1. Introduction

The World-Wide Web [Berners-Lee et al. 1994] has revolutionized computing and brought hypertext from the realms of academia to the common computer user. It has become a distribution medium for a wide variety of content, from course handouts to sports scores, from virtual museums to online games, from professional magazines to amateur 'zines. However, as the web has grown, the size and design problems of creating sites have also grown. These range from the details of ensuring that each page has correct HTML markup and valid links to providing a uniform design or "look and feel" for the pages in a site and supporting site-wide changes to those designs.

What are the tasks a site designer, developer, or maintainer faces? They include

- *translation* from non-HTML materials to HTML;
- *organization* of the pages within the site;
- *retargeting* of existing materials into a new form;
- *gardening* to remove inappropriate pages and links;
- *automation* of common tasks;
- *separation* of the various roles in site design (e.g., page designer, instructional designer, content author);
- *extension* of the site with additional features, such as search engines;
- *analysis* to support site development, design, and maintenance; and
- *verification* of links and markup.

While a number of commercial tools have appeared to support page designers (e.g., Navigator Gold, Claris HomePage, Adobe PageMill), the corresponding commercial site-level authoring tools rarely offer sufficient support for the more complex tasks involved in maintaining a site. For example, while commercial site-level

tools may be able to check whether all the links in a site are valid, they rarely support bi-directional linking or retargeting of site content.

Fortunately, a number of academic site-level authoring tools have appeared that support a wide variety of authoring tasks. These systems include ASML, the automated site markup language [Owen & Makedon 1998]; CourseWeaver [Rebelsky 1997], Gentler [Thimbleby 1997b], HtX [Salter 1997], I-CARE [Chang 1998], Siteview [Thimbleby 1997a; Thimbleby 1997c], WebCT [Goldberg 1998], and WebMapper [Freeman & Ryan 1997]. Because these tools were created by web developers who had encountered the many problems of site design, they provide a wide array of tools for site authors. At the same time, they differ significantly in how they approach site-level authoring and in the particular tools they provide.

The remaining sections of the paper visit these topics in greater depth. [Site-Level Tasks] revisits the tasks that site developers, maintainers, and creators face. [An Example: Reusing Existing Materials] presents an example of site-level authoring. [Academic Systems for Site-Level Authoring] summarizes the design goals and use strategy of each site-level authoring system. Finally, [Alternatives] suggests alternatives to these tools.

2. Site-Level Tasks

There are a variety of types of tasks that web designers, maintainers, and developers must complete in order to build and sustain successful webs. These include translation, authoring, organization, retargeting, gardening, automation, separation, extension, analysis, and verification. Yet each of these tasks involve a number of subtasks. The following paragraphs are intended to illustrate some of these tasks and subtasks that site-level authoring tools might support.

Translation. Many sites are built from a set of pre-existing resources that are not yet in HTML format. These resources will need to be *segmented* into appropriate-size pieces, marked-up to preserve the original intent or design, *redesigned* to accommodate the differing needs of web users, and *linked* to and from additional resources.

Authoring. In addition to existing materials, other materials must be newly created. While content can often be created some standard format and then translated, there are many benefits to authoring within a system (e.g., so that linking to related pages is easier and so that less effort needs to be devoted to translation).

Organization. The materials within the site need to be organized into one or more *hierarchies* and *trails*. The must also be linked to each other. The hierarchies, trails, and links help both novices and experts peruse materials in appropriate orders.

Retargeting. Few sites are static entities. Frequently, site designers find new and better ways to present the same information. For example, one might decide to *segment* documents into smaller pages to provide more accurate search results. At the same time a designer might want to *join* pages into a larger page so as to support printing or reduce the number of http requests sent to the server. A designer might also find it necessary to provide *alternative versions* of each page, such as pages with and without frames. As a site evolves, designers may deem it necessary to redesign pages. Finally, it may be necessary to *transport* a site from one location to another, maintaining and updating links as appropriate.

Gardening. Nielsen [Nielsen 1996, item 9; Nielsen 1997, item 5] suggests that at least half of the resources (time, people, etc.) allocated to a site should be devoted to maintenance of the site. This includes *deleting* unused or inaccurate pages, *checking* that links are correct, *updating* information on pages, and even *redesigning* pages.

Automation. Many of the tasks involved in web design are relatively repetitious and mindless. These include *determining* the appropriate width and height tags for images, *linking* to nearby pages, and *inserting* the creation and modification dates of pages. If tasks are sufficiently repetitious, a tool should be able to automate them.

Extension. Most sites are more than just a set of text and images. Users now expect to find search facilities, site maps, guides, glossaries, and other tools to help them use and navigate the site. Often, the systems that develop the web are best suited to providing these extensions to the site.

Analysis. In order to successfully maintain a site, a maintainer must know which pages are an are not accessed, when the pages were last updated, how easy it is to get to a page, how users commonly get to pages, and other similar information. For academic sites, it may be particularly important to determine exact usage patterns, including the path each student took through the web and how much time each student spent on each page along the way. While some of these tasks can be done by web log analyzers, others need to be supported by additional tools.

Verification. All too often, the HTML in web pages is incorrect. This may even be true for HTML created by a page-authoring tool. While the incorrect HTML may not be apparent in the author's browser or operating systems, the problems may crop up for other users. Hence, it is important to verify that each page is correct. In addition, users are frustrated by non-working link, so a site-authoring system may support verification that local or nonlocal linked documents exist.

3. An Example: Reusing Existing Materials

The aforementioned tasks may be illuminated by a particular example. Consider the problem of converting the manuscript for a book or thesis into a useful hypertext. In order to do that, one must first determine an appropriate level of levels of segmentation. For some, the printed page seems appropriate, and there are sites that precisely mimic printed books. However, in most cases, a more hierarchical segmentation is appropriate. The book may be segmented into chapters, which are then segmented into sections, which are then segmented into subsections, which are then segmented into paragraphs. While the author may have provide some segmentation (most often into chapters), it is necessary to further segment the document, and it is preferable to have a tool do that segmentation. Once segmented, the original markup on each node must be converted to HTML (or removed, when appropriate). In addition, the nodes must be incorporated into pages, with an appropriate design for each page. These are all problems of *translation*.

Once the individual nodes or pages have been created, they must be linked. The tool that did the segmentation might automatically add links to siblings and parents. It can also give a clear *next* link, thereby helping avoid the problem of readers becoming "lost in hyperspace" [Nielsen 1995]. At the same time, one might develop an index, so that a reader can quickly determine which page is appropriate The development of these links and index is one of the types of *automation*. A search engine built on top of the index is one of the *extensions* a site-authoring tool might provide.

Because problems can occur in each of the preceding stages, it is now important to verify that the HTML on each page is correct and that the links are valid. While many systems provide mechanisms for checking links, most leave HTML validation to other tools, such as weblint [Bowers 1996]. Such checks are examples of *verification*.

Often, the translated web will be tested on a local system, perhaps using `file` links rather than `http` links. Once it is ready, it must be converted for use by a broader audience and possibly moved to a new machine. It may also become clear that those reading the book on the web prefer to make printed copies. For such users, it becomes important to join all the nodes in a single chapter into a single page. These are all examples of *retargeting*.

Unlike printed books, online books are often expected to change as information changes. Hence, as the data this translated book refers to change, the sections that refer to those data must also change. The identification of sections that must change is a form of analysis and the updating of the sections is a form of *gardening*.

Many of the previous tasks may have been done by different team members. For example, a designer may have been responsible for the overall design of pages while the author of the original text is responsible for the content and an analyst for doing the analysis. A good tool will support this *separation* of tasks.

4. Academic Systems for Site-Level Authoring

A surprising number of site-level authoring systems come from academia. Why is this? Often, it is because those in academia are regularly forced to confront the tasks of translating large quantities of existing content (e.g., notes by a famous instructor) or reconfiguring existing sites (e.g., those designed early on in the history of the web so as to take advantage of new features). At the same time those in academia often have the expertise in programming, hypermedia, instructional design, and human factors to design such systems. Many of the following were created in response to a site or sites the developers were asked to create.

Note that this is not intended to be a comprehensive description of site development tools. Rather, it is intended to suggest the different directions the designers have taken and the different issues they have chosen to emphasize.

4.1 ASML

ASML[Owen & Makedon 1998], the automated site markup language, is a hybrid markup and programming language that supports not only HTML, but any markup language. It is, in effect, a "markup language for markup languages". An ASML site is typically described in a single document. The contents of the site may be stored in separate files which ASML can include within the files it generates.

The site-description document may include normal markup (e.g., in HTML), special ASML tags, ASML commands (for loops and conditionals), and ASML variables. The special ASML tags are used to automate many common tasks, such as determining the size of images and providing accurate links to other documents in the system. ASML supports both site-level and subsite-level indexing, so that a site developer can create both general and custom search engines. ASML also supports custom translation of rich text format files, so that a designer can specify what physical formatting commands from RTF are used to indicate particular logical formats, such as section headers.

ASML allows parameterized *macros* and *templates* that describe how to translate part or all of a document. For example, one might create a head macro that generates document headers with titles that include both the site name and document name.

Much of ASML's power comes from its use of lists. In ASML, one can easily define lists (of terms, documents, components, etc.) and then apply actions and macros to each element of the list. For example, one might make a list of page bodies and automatically wrap additional information around them (such as navigation facilities). A slight modification to such code makes it easy to create an accompanying table of contents.

4.2 Gentler and Siteview

Gentler [Thimbleby 1997b] is a tool developed for *systematic site authoring*. It encourages design for maintenance, in that it requires site authors to develop pages in such a way that they are easy to maintain. It provides macros for page layout and permits separation of page design from content creation. Interestingly, Gentler can generate Mathematica specifications of document linkage so that developers can easily visualize their sites.

Gentler has since been supplanted by Siteview [Thimbleby 1997a; Thimbleby 1997c]. Like Gentler, Siteview supports design for maintenance. More importantly, it permits authors to develop their documents directly in HTML, using the HTML creator of their choice. Site authors can insert commands to get and set annotations of pages which can then be used in other pages. For example, a page may define an icon and other pages may then include that icon and automatically get a link to the other page. Similarly, one page may refer to the title of another page, and Siteview will automatically insert that title. Siteview provides a wide variety of facilities for specifying linkages between pages, and even permits bi-directional links (so that a designer can ensure that for every link from page A to page B, there is a corresponding link from page B to page A).

Much of the design effort in Siteview has been targeted towards *distributed web authoring*. The author of a Siteview page can indicate which pages that page should precede, follow, or be "below" in a standard hierarchy. The templates allow designers to indicate necessary components of pages and to specify the overall layout.

4.3 HtX

HtX [Salter 1997] supports a three-tiered form of web development. Each HtX *information space* has three components: the content, the design, and the topology. Because the three components can be written separately, it is possible to segment the tasks of writing, designing, and linking a site.

Unlike the other tools, in which documents are primarily based on HTML, in HtX documents are based on LaTeX. HtX's community, initially mathematicians and computer scientists, are familiar with LaTeX, so it provides an appropriate base markup language. Like the other tools, HtX supports multiple designs for the same content.

4.4 WebCT

WebCT [Goldberg 1998] is a site development system targeted at educational authors. It provides a rich set of tools to support course webs, including online testing, student tracking (of tests and of pages visited), user-oriented page annotations, and automated linking to a glossary.

Unlike many of the other tools, which expect development of pages and sites to be done in a separate application, WebCT permits almost all site development to be done within the WebCT application (in effect, by visiting web pages and selecting or entering options). However, WebCT does require that the course content be developed separately (using an authoring or translation system).

4.5 WebMapper

WebMapper [Freeman & Ryan 1997] is a site-level authoring tool targeted towards educational authoring. As such, it concerns itself with many of the problems of educational design. In particular, it permits content creators to give high-level descriptions of page components and instructional designers or artists to fill in the details. In also uses *concept maps* to ensure appropriate relationships between pages in the site.

5. Alternatives

It is arguable that many of the tasks subsumed by site-level authoring systems can be handled in alternative ways. One might use (1) standalone tools, (2) CGI scripts, (3) client-side scripts, or (4) more powerful web authoring systems, such as HyperWave [Maurer 1996].

For each component of a site-level authoring system, there is likely a standalone application that can serve the same purpose. For example, instead of using a site-level authoring tool to join a number of pages into a single document for printing, one can use html2ps [Kärrman 1997] to join the pages, create a table of contents, and number the sections. On the other hand, using a number of independent tools can lead to confusion about how to use each tools; site-level authoring systems can ensure uniform interfaces for the tasks one has to complete. Site-level authoring systems can also support external tools like html2ps by inserting commands for those tools into documents.

CGI scripts can easily handle many tasks, particularly providing multiple versions of the same document or inserting custom information into documents. In fact, some of the aforementioned tools provide a CGI interface. However, CGI scripts can consume significant processor time. More importantly, by using site-level authoring tools, one can generate pages for a system that does not support CGI or certain CGI scripting

languages. In addition, site-level authoring tools can often be used to generate appropriate CGI scripts, if CGI scripts are desired.

Another option is to have the client browser do much of the work, using client-side languages like VBScript, Java, or JavaScript. Unfortunately, not all browsers support these languages and there are multiple versions of some languages (e.g., JavaScript). Some of these tools, such as WebCT, rely on JavaScript to support many of its features.

The most reasonable alternative is to use a better hypertext system. HyperWave [Maurer 1996] is one of the best Internet-based hypertext systems available, and provides many of the features that the World-Wide Web lacks, including bi-directional links, automated searching facilities, and support for a wide variety of document formats. It can even produce HTML and act as a WWW server. However, many institutions have a significant investment in HTML and HTML expertise and may be reluctant to give up that investment. In addition, HyperWave is not available on all platforms (the lack of a Macintosh version of the client is one serious flaw).

6. Summary

Site-level authoring presents a host of problems and tasks that page authors did not previously need to consider, from document uniformity to analyzing the linkage of documents. A number of systems have appeared to meet these needs. These systems provide a variety of perspectives on the problems of site-level authoring, and solve these problems in a number of different ways. For each site, there is likely to be an appropriate system or set of systems for developing, maintaining, and updating the site.

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Cognitive and Social Functions of Course Web Sites

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Abstract: The work reported here is part of an ongoing qualitative study of faculty uses of the Internet. The goal of our work is to categorize the functions of class web sites from both researcher and faculty perspectives. Using a qualitative content analysis approach, we first analyzed the functions of 25 publicly accessible class web sites. We then interviewed a subset of the sites' authors. We found that all sites performed course management functions valued by instructors; that a small subset also demonstrated easily implemented, successful, and pedagogically interesting uses of the web; and that pages in our sample conveyed implicit and explicit social information to students about the class and instructor through four primary channels.

Introduction

When the possibility of using the Web to teach my course became available, I knew that I had found my answer. I was now able to provide information and pictures to my students at a pace to fit their needs. My incentive for using the Web-based instruction was simply to provide the students the best possible method for them to learn the subject matter. [Dr. Charles W. Heuser, Jr., cited in Williams & Peters 1997, p. 108]

Administrative propaganda routinely alludes to an alleged student demand for the new instructional products. At UCLA officials are betting that their high-tech agenda will be "student driven," as students insist that faculty make fuller use of the Web site technology in their courses. To date, however, there has been no such demand on the part of students, no serious study of it, and no evidence for it. [Noble, 1998]

It is hardly surprising that there are both enthusiasts and opponents among academics when it comes to utilizing an innovation as controversial as the world wide web (WWW) in higher education. Universities and colleges are spending huge sums on networks, computers, and software to support the integration of the WWW into courses, and faculty are appropriately vested in scrutinizing any such investments of scarce academic resources. Recently, a backlash against using the web in higher education has received wide publicity in North America (Noble, 1998). In the midst of such controversy, it is essential to examine what individual instructors are doing with the WWW in their courses.

This paper reports on a qualitative investigation of instructional uses of the world-wide web (WWW) at The University of Georgia. This study focuses on "class pages," i.e., web sites that have been personally developed by instructors to support traditional face-to-face classes, rather than those rare courses that are primarily delivered via the WWW. The participants in this study are early adopters of the web for instruction. Their sites, typically developed with little or no computer assistance nor instructional design (ID) support, range in complexity, interactivity, and function.

The goals of our research are, first, to describe how instructors "naturally" use the web to support instruction, specifically how those without technical training or ID support use the web instructionally, and second, to describe how instructors themselves perceive the impact of their pages on instruction. Our first step was to critically assess a sample of existing, faculty-developed class pages from multiple perspectives. Next, we interviewed a subset of faculty members who developed the pages we had assessed, to understand how they conceptualized the functions of their pages. These data provide a snapshot of the current state of web-based instruction at one institution, and give us insight into the diverse and sometimes unexpected instructional and social functions of class pages.

Content Analysis of Class Pages

We selected a sample of 25 class pages that were publicly accessible from our university's homepage, including graduate and undergraduate courses from disciplines such as astronomy, biology, economics, education, mathematics, pharmacy and veterinary medicine. We then categorized the instructional elements of these pages, adding categories and revisiting pages until we felt that all the functions represented in our sample were described. The results of this initial qualitative content analysis are presented in [Fig. 1]. Despite the range of possibilities for class pages, we found that most sites are static, consisting only of course-relevant text such as syllabi, course notes, and procedural information such as attendance policies. All 25 pages served *course management* functions, conveying information about class schedules, instructor availability, and required texts. Most class pages also included *instructional text* such as lecture notes or articles. Fewer pages displayed content-related *graphics*, made extensive course use of *Internet resources* through hyperlinks, provided downloadable *software or digital files*, or promoted *communication* via E-mail, listservs, or newsgroups.

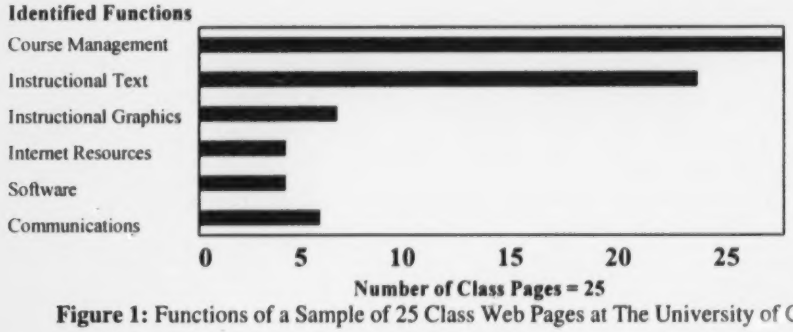

Figure 1: Functions of a Sample of 25 Class Web Pages at The University of Georgia.

We next considered the pages in light of a model of classrooms as learning environments. Perkins classifies the features of classrooms as learning environments in terms of five functions or facets. These include: *information banks, symbol pads, construction kits, phenomenaria,* and *task managers* [Tab. 1]. Of these five facets, most sites serve only two roles: information bank and task manager. To the extent they provide course content in the form of lecture notes, references, or domain hyperlinks, pages are, like textbooks, *information banks*. In providing assignment schedules, answers to homework problems, and test preparation suggestions, pages function as *task managers*. Our analysis suggests that instructors are quite comfortable using web sites as information banks and task managers. Pages function less frequently as construction kits or phenomenaria, the facets most associated with rich, student-centered learning environments. As an exception, a math education instructor in our sample uses his pages to disseminate Geometer's Sketchpad files and spreadsheets to students whose machines had the appropriate helper applications. Subsequently, students used the associated software tools to build their own problem solutions and posted them back to the web site for critique.

Facet	Function	Class example	Web example	n*
Information Banks	Provides content information	Textbook, instructor	Domain-relevant sites	25
Symbol Pads	Supports off-loading of cognitive tasks	Calculator, word-processor, pen & paper	Groupware functions	1
Construction Kits	Provides domain-relevant tools to support creative activity	Lab equipment, Systems modeling software	Domain-related web products (i.e. teachbacks)	2
Phenomenaria	Makes phenomena accessible to scrutiny and manipulation	Microworlds, fishtanks	Realtime data; Domain activity as it appears on web	1
Task Managers	Sets, guides, and provides feedback on course tasks	Instructor, "study guides," & students themselves	Online syllabi	25

*from Perkins (1991) +the # of pages in our sample (N=25) displaying these aspects.

Table 1: Cognitive Aspects of Learning Environments Represented in Class Web Pages.

As accessible and enduring documents that describe courses and provides samples of typical class activity, class pages also serve a valuable socializing function. They offer students a variety of clues to their instructors' goals, beliefs, and attitudes toward teaching, learning, and class structure. Some clues are implicit, some explicit, but all are useful to students

as they build a model of successful behavior in that class setting. As we scrutinized class pages, we became aware of a diversity of social information. Using qualitative content analysis, we categorized the social functions we saw represented in our sample of pages. We identified four social aspects of classes that instructors convey via their web sites: *behavioral expectations*, *course philosophy, class community*, and *instructor persona* [Tab. 2].

Facet	Definition	Examples from UGA Class Pages	n
Behavioral Expectations	Descriptions of expectations for student behavior in course.	Attendance policies, class participation expectations, sanctions, etc.	22
Course Philosophy	Explicitly conveys attitudes regarding student-instructor interactions and roles.	Learning contracts, philosophy statements, meaningful quotes about learning or teaching, etc	2
Class Community	Graphics or text which support sense of the class as a community.	Digitized images of class interactions, linked student homepages, daily class logs, etc.	3
Instructor Persona	Graphics or text which convey instructor's personality.	Pictures of instructor, non-instructional cartoons, animations, "fun" links etc.	5

Table 2: Socialization Strategies Found Within Class Pages.

To the extent that cues in each of these areas rely upon text, they might be delivered equally well by a print course syllabus distributed on the first day of class. However, within the sites we observed, the web extends the socializing power of the traditional syllabus document in at least three ways: through page design, community building mechanisms, and personalization. First, user-friendly html authoring systems and graphics software packages allow instructors to visually emphasize the issues that concern them most, be they behavioral, instructional, or attitudinal. Using templates and tools, instructors can present their students with web pages that have high face validity; they look professional and important, especially for those students to whom the WWW is still a novelty. Conversely, lack of attention to design (look and feel) elements such as background color and font choice may inadvertently convey an impression that the instructor does not intend. Second, instructors use class pages explicitly to define and to support the social environment they desire in their classroom. The most common community building strategy is to provide links to student home pages. Other community building strategies used by instructors in our sample were to post top student projects as exemplars, to encourage collaborations among students by using the site as a public area for posting and critiquing class work, and to keep up a continual, if one-sided, dialog with students about class activities and achievements through a "class log". Third, some instructors use their web pages to give students information about themselves outside the range generally found in course documents. This may be no more than a link to a current vita, perhaps including a picture, or it might be a link to a homepage featuring family and hobbies. Other pages invite students to see their instructors as "people not professors" through blatant personality indicators such as goofy photos, "fun links," and graphics, animations, or links that are unrelated to course content.

The findings reported above suggested to us that, from a social perspective, class pages might convey significant information to students about behavioral expectations, about the relationship they can anticipate with the instructor, and perhaps about other features of the class as a social learning environment. From an instructional perspective, using the web to provide text online to students may be seen by instructors as its legitimate, even sufficient, function. This usage may have obvious benefits as a way to centralize course information, to facilitate faculty-to-student transfer of current course documents, to reduce time-consuming but low-level interactions with students outside class, and to transfer printing and duplication costs away from the instructor. In analyzing web sites without reference to the intentions and ensuing instructional experiences of instructors, we largely saw course management and text transfer functions represented. As unsurprising as it may be that instructors initially transfer their print-based teaching approaches to the web, the potential of the WWW to enhance teaching and learning is barely tapped by these fundamental applications. However, our view of site functions was expanded through faculty interviews.

Interviews With Instructors

The observational results described above led us to interview faculty members whose pages we had analyzed. Our primary

goal in these interviews has been to identify instructional, cognitive, and social outcomes instructors attribute to their class pages. The grounded theory approach guided our data collection and analysis, entailing purposeful selection of participants, semi-structured interviews, and constant comparative analysis. The results reported here include data from five interviews with instructors whose pages were particularly rich in social information, instructional resources, or both. Demographic information about the participants is provided in Table 3.

Name*	Faculty Rank	Past Instructional Technology Use?	Typical Class Size	Selection Basis**	Unique Page Features
Denise	Assoc.	None	100+	S	Exuberant I" person descriptions, graphics
Michael	Full	Used PowerPoint to support class lectures	100+	S	Extensive data on self as teacher (teaching ratings, etc.); lots of work on layout
Hal	Full	None, but 30+ years programming	100+	I	Material extensively hyperlinked, daily log with internal and external links to relevant resources, realia
John	Full	Consistent PC and software use in instruction	~20	S / I	Prominent link to personal homepage w/ family, interests; posted student productions, realia
Phil	Assoc.	Consistent use of CAI, e.g., Toolbook, Authorware	100+	I	Posted student productions, instructional games, official course notes

*Pseudonym

** S = Social features of website; I = Instructional features of website

Table 3: Profiles of Interviewed Instructors.

Tape-recorded interviews occurred in participants' offices with one or both researchers, and were subsequently transcribed by one of the researchers. Our semi-structured interview protocol included nine core questions:

- How are you using the Internet to support your research activities?
- How do you use the Internet to support service activities?
- What were your goals in creating your course page?
- What effect has the page had on instruction?
- How has the page affected the social aspects of teaching your class?
- What problems have you had with the course site?
- What do your colleagues think about your site?
- What are your plans for changing the site?
- Could you tell us your predictions for the web in higher education?

In the present discussion we confine ourselves to the subset of findings most relevant to the instructional and social functions of our participants' pages. Our observations from the content analysis about the dominance of course management and information bank functions of class pages were borne out in every interview. The pages served faculty well as a way to provide central access to course syllabi, daily updates, and changes to the class schedule, or to facilitate transfer of text-based content resources or software. These "housekeeping" functions reduced repetitive and time-consuming interactions with students.

> *[S]tudents always come up and say "I wasn't here on Tuesday, what did we cover? So this takes care of that, it also gives them a way of having announcements, so I don't have to get any of this "Is there anything I missed?" kind of stuff.* - *Denise*

Participants commented that course pages helped students build web skills, although this may not have been an instructional goal in the first place. In addition, Phil, a professor in the school of veterinary medicine, found that his students used the web to locate and consult resources for equivalent courses at other institutions, thus breaking down institutional borders in instruction. Due to a unique feature of his page (professionally-taken class notes that were posted within 24 hours of a lecture), Phil described reduced note-taking (greater attention) by students during lecture. Phil, Denise, Hal, and John all noted increased student engagement, effort, and time-on-task with class web activities:

> *And I really don't know how to attribute to the web or the course or what, but these students really work long and hard on stuff much more than I've explicitly said I want them to do.* - *John*

It should be noted that all these faculty members were also aware of the potential novelty effect that could be working to their benefit as early adopters of the WWW.

Michael differed from other participants by conceptualizing and experiencing the web primarily as a mode for conveying information, rather than as a technology that provides unique and motivating affordances for instruction:

> *I think for some, and this is where I've come with the web page, where I'm at right now, for some students the web page is a godsend. For people that aren't real well organized, that need to know where are Dr. X's notes, and there they are at 2:00 in the morning trying to track down a page of something. For some students, whatever their needs are, the web meets those needs very, very well.* – Michael

Among those interviewed, Michael's site was the "flattest" in the sense that it provided content in the form of notes, a syllabus, and information about the instructor, but did not engage the students any further through web-based activities.

Two findings from the interviews indicate unexpected ways that course sites may actually correspond to Perkins' [1991] descriptions of learning environments. For Denise, the web itself might be described as a form of phenomenaria where the phenomena under scrutiny is the vast diversity of course-relevant information itself. Denise assigns her students an extra credit project in which students receive points for providing new URL's for her "links" page. The sites must be pertinent to the course, new to her list, and evaluated by the student.

> *And one of the things I love about [the web]–which is probably the bane of some people's existence– is: everything is open to you. You just have to sift through until you find what you want. But when you say "green dogs" you're going to get everything from scientific papers on green dogs, to my dream about green dogs, to the green dog in Australia. And I love that because it's wonderfully--broadening--is the way I'd put it.* – Denise

The open world of the Internet gives students a window on the breadth of their topic, participants in the topic, and topical variations on key words. This diversity requires that students be able to, as Denise said, "sift through" information and make informed choices about "what you want."

Our interviews also suggest that publicizing student work can transform "information bank" and "task management" aspects of a course by transferring these functions toward the student. As we suggested in the first part of this paper, the Internet facilitates publicizing academic work in more than one way. For example, listservs and newsgroups can publicize thinking through correspondence, or, once a professor has a web page, it can be a relatively simple matter to post student work publicly. Denise and John, the two participants who capitalized most on this aspect of the web, provide clear indications of the benefits. For example, students can use each other as content resources (information banks):

> *I thought that one of the things that was interesting was that the students would use themselves as resources. They would go on the newsgroup and say you know, "Number 16 is just-- I'm getting this--and I'm not sure it makes sense? Is everyone else getting this or is there something else going on?" And other students would come up with what they were doing. Which was really wonderful* - Denise

Of course students will consult each other as course resources, web or no web. The difference is that in a public forum like a listserv or newsgroup, non-participants can also benefit from these peer exchanges.

The findings presented in this section remind us of the unanticipated benefits that can result from experimentation. All five of our participants began their sites with narrow goals of supporting instruction with a centralized content base: an "information bank" function. Four of them also wove Internet-specific functions into their sites, such as:

- extensively hyper-linked content;
- "one stop shopping" in which course, communication, and Internet search resources are centrally available;
- repositories of student work online; or,
- web-based student assignments.

One widely shared observation among our respondents was that student-instructor interactions changed in response to the course page: the page and class use of the Internet provided something new for students and instructors to talk about. Similarly, the page can be team-building in the sense that it creates a shared experience for students, even across class sections. For true novice web-users like Denise, dealing with quirks or problems with the page provided a shared problem-solving experience for her and her students. Our interest in how course pages convey social information centers on how they might influence student beliefs and expectations about the instructor or class. We found that instructors described two effects which we termed "equalizing" and "humanizing." Class pages can humanize the learning experience for students by giving them access to other, non-academic views of their professors. The humanizing function of pages is

closely related to the idea of equalizing the status between students and faculty. Our interviews support our conclusion that some faculty explicitly recognize this equalizing effect:

> *Students have told me that it sort of energizes them and they get an idea of who I am, and I don't feel so aloof to them when I see them, as though I'm this far away professor.* – Denise

The idea that course pages can serve the instructional function of reducing the role of the instructor as an omniscient external authority deserves further investigation.

Our interview data also indicate that the social effects of pages for instructors far exceed the boundaries of the class as a social unit. Perhaps some of the most important outcomes are not between instructors and their students, but rather between instructors and their peers. Although these findings are outside the scope of the current paper, briefly, our respondents report that their pages have, for example, changed colleagues' view of "who they are" and "what they can do," or have provided entrée for meeting people at national meetings.

Conclusions and Directions for Future ResearchAlternative Evaluation Models for Course Web Pages

Our work suggests that, although instructors' stated goals are functional and pragmatic, outcomes exceed expectations seemingly in proportion to the degree instructors use the unique qualities of the web. Similarly, while instructors may want their pages to perform "housekeeping" functions as a baseline, they are interested in understanding the more substantive instructional functions that their pages may potentially perform. Our perspective on course sites' *task management* and *phenomenaria* functions changed in the interview phase of the study. By publicizing student work, the course sites may encourage students to take more responsibility for task management. The totality of web-based, domain-related activity might be construed as phenomena that instructors can build into their courses. In addition, the interview data largely supported our content analysis of class pages as delivery vehicles for socio-cultural information. The casual, grassroots history and culture of the web may inspire some faculty to present themselves differently on the web than they do otherwise, thus humanizing and equalizing the class learning environment. Conversely, the self-selecting group of early adopters may be those who already strive for a collaborative model of instruction.

Along with continuing our interviews and introducing student perspectives into our work, as a next step we are conducting a campus-wide survey based upon our interview results for studying course web sites. A flurry of instruments and models have begun to appear to assist in evaluating web pages designed for teaching and learning. Different evaluation schemes have focused on criteria such as content, user interface, page design, implementation, and utility. While there is considerable creativity in many of these schemes, none highlights the cognitive and social functions of web pages. In addition, the existing instruments are mainly meant to be employed by external evaluators. We believe that practical evaluation of course web sites demands an internal perspective. The current interest in web page evaluation and research provides many interesting opportunities for further R&D. Ultimately, we may be able to examine and enhance more significant aspects of courses such as the cognitive and social aspects we describe above. After all, if nothing else, course web pages have the potential to throw open the classroom door to reveal what really happens within specific classes. The very act of making public one's syllabus may be just the spur some faculty need to consider more carefully and improve the articulation among objectives, assignments, tasks, and assessments within their courses.

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Carnegie Mellon Online

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Carnegie Mellon Online is a unique, data-driven, database supported, educational infrastructure that takes advantage of the World Wide Web to provide student-centered instruction. The system generates customized content (e.g., assessments, feedback) for each student and tracks the student through a course while maintaining course-specific rules and policies. Using this system, the instructor sets guidelines and prerequisites for student advancement through the course material, allowing the progress of each student to be individual and paced for his or her learning style. It also provides students with more control over their learning experience by permitting them to access their course materials at any time they choose and as often as they choose, as best suits their needs.

Carnegie Mellon Online is not limited to a specific discipline or type of course. Both science and humanities courses can make use of its unique, student-centered approach to education in a variety of ways. It can be used to offer completely online courses that never meet in a classroom, it can act as an online management and learning tool to complement classroom-based courses, or it can be used solely as an assessment tool. It incorporates both educational delivery and instructional management tools, educational content sharing across courses, and is scalable from small to large courses.

In this presentation, we will demonstrate the system in use in both science and humanities courses. We will illustrate from both the student and the instructor perspective the delivery of multimedia learning content; individualized assessments, grading and feedback; course management; and multiple site-navigation systems.

Implementing a Web-Based Student's Admission System

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Abstract: In recent years both technological and economical factors affected and raised the popularity of higher education in Lithuania. On the other hand, today's students are concerned by the problems in the job market and select universities to study which they feel will lead to a better job opportunities. There is a certain level of competition among new students and every University must deal with it accepting appropriate selection criterions and procedures. This short paper focuses upon the implementation of the Web-based admission system to the University. We'll look at opportunities and challenges that networked admission system offers for high school graduates, their parents, school teachers, and also in what extent it aids university administrators.

Introduction

The higher education system in Lithuania is on the way of radical transformation. Change is occurring in managerial and academic structures, organisation of teaching and research, student profiles, funding mechanisms, to mention just a few aspects here. Transformation couldn't leave steady a conventional admission system being used for forming a new student contingent. This change is to a great extent being enabled and driven behind by advances in IT. In particular, the reach of educational institutions is expanding via the WWW and increasingly important development therefore rests with the provision of distributed services and the implementation of networked applications. This paper is aimed at presenting initiatives taken by Kaunas University of Technology in Lithuania to implement a web-based student's admission system. The paper describes the structure, use and experience of using WWW as the mean of providing a convenient access to enrolment data making the admission process open, flexible and transparent.

Background

Since 1996 KUT adopted a scheme of preliminary admission to the University. It means that high-school graduates are invited to apply to the University a nine months before graduation exams and if a competitive grade, characterising quality of their work in the school meet a certain level, they might be invited to study at the University without competitive examinations. One of the first tasks was to identify components of the competitive grade. As a main component was accepted a numerical merit reflecting student's performance during several last years in the high school. To evaluate that applicants must submit the form providing certified marks of the six basic disciplines gained during last 4 years in the school. The mathematics, physics, chemistry, mother and foreign languages are recognised as basic subjects, the average mark is taken for each one. Additionally other educational distinctions, like prize-winner in international or regional educational competition, are also taken into consideration. Then a competitive grade consists of sum of three disciplines averages plus some, if any, evaluation of distinctive academic achievements in the school period. Which three disciplines are chosen depends on the profile of the faculty. Usually the evaluation figure of any one person doesn't exceed 33-34 because the highest mark for any discipline is 10. The competitive grade obtained is being used to sort out a list of candidates selectively to each faculty. It should be anticipated that all applicants' data are put into a data base and it is being updated when any new applicant comes in.

The next step was to define the rules of the enrolment procedure. Each applicant may express his willingness to study in one of three faculties giving a highest priority to the first put in the list of his application form. The admission starts at the beginning of November and ends up with forming of 100% student contingent in the middle of July. There are two crucial dates in between when an enrolment is performed. The first, in mid of December, when University officially announces that a number of students from the top of the each faculty list are invited to study at the University providing successful school-leaving certificate. At this step only about 30% of student contingent is admitted. Any new applicant, even very high ranked, which comes after this date, goes into the applicants' list and is unable to push out any one from the bottom of the students' list. He may be selected to study during the second identical enrolment procedure which usually takes place in April. After those two stages the University considers having about 75% of students. The rest 25% is being selected by conventional competitive examinations on basic subjects depending on profile of the faculty.

Approach - What Has Been Put on the Web?

The University runs Information System built on site wide area network and file server facilities. The system currently is going to be reconstructed considerably aiming at provision of on-line services for academics and administrators. Within scope of that, the admission system project is focused on the design and implementation of the applicants data base facility and its interface via the WWW. In brief the project is aimed to:

- develop a facility for open access across a network to up-to-date admission data for various categories of users – applicants, their parents, school teachers and administrators,
- provide an appropriate mechanism for admission process control, management, monitoring, which facilitates admitting and greatly aids to deal with admission data.

What has been put on the Web? The introductory pages were created, where you can get acquainted with admission rules and regulations. When you select the button "Our new students", the Lithuanian map with regions and cities appears on the screen. By 'pointing and clicking' on the area you are interested in, the list of schools of that region or city is brought up on the screen. It is essential, that the list obtained isn't static HTML document, but actually it is a table created interfacing Oracle data base. It contains school names and total number of applicants from each school, among them a number of admitted. Selecting one particular school you can get more detailed information up to characteristics indicating quality of applicant's work in the school.

As have been discussed above, there are two important dates when enrolment procedure is being run and database 'replenished' with important information. After this date applicants may find themselves as invited to study or admitting for them may be postponed. In the second case one can be additionally informed that his/her grade is clearly insufficient to be admitted this year into the faculty pointed as a 1^{st} or 2^{nd} in the application form. Therefore he/she is suggested to rethink and make another choice based on information available. Its essential, that after enrolment procedure there is a lot of information available on the Web for those, who appeared outside the bounds of desired faculty or were not invited to at all. Web-based interface to applicants' database may provide a variety of ways to individuals in which they are able to estimate realistically a probability to get invited into one or another faculty on the next stage. If the probability is critical, one can start a special training to get ready for competitive examinations or even to change mind and apply to another University.

Conclusions and Perspectives

Our two years experiments with the system have been very positive. There is a rapid growth of interest in the use of the system because more than 70% of Lithuanian schools have access to Internet. The realisation can be viewed at *http://www.pit.ktu.lt/abiturientas.html* , but it is only in Lithuanian because the purpose of the system.

The success of the system can be attributed to several factors. At first, it offers constant and convenient access to up-to-date enrolment data. It allows for individuals to estimate realistically chances to study in the University. Furthermore, not only high school graduates but also lower level students can view and analyse admission data. The younger ones getting acquainted with admission rules and making year or two forecasting can intensify their studies in order to be competitive to enter one or another faculty in the future years.

Secondly, the system has allowed for enchanced communication between the University and high education institutions. It provides means for comparative analysis of data as regards to the level of teaching in different

schools and/or regions. Teachers, parents and school authorities can access own as well as other schools data and get familiar with how their students fall into rank, how many of them were invited and into which faculty.

Finally, the system has greatly aided us to deal with a huge amount of data and ensure providing of open and flexible admission service. After all, the usage of the system results in building of ready to use new students database to be used for studies management and administration during following four study years.

Yet there are many issues that need to be resolved before such a mode of admission becomes available in full extent, and by no means all of them are technical. The important issue is ensuring the data reliability, which was partly achieved making data open to access via the network. Openess itself initially has been also accepted quite suspiciously. The system still is not adopted by other universities in the country, not having their admission data base facility they use a traditional enrolment scheme through examination and that fact causes sometimes a competiteveness problem so far. Nevertheless, the web-based system proved to be very flexible and attractive for high school community. There is an evident need to build up an interactive applications allowing applicants to act according to the scheme 'what would be if...' exploring last year or current year admission data base.

Using Agents as a Currency of Exchange between End-Users

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Abstract: The Behavior Exchange is an AgentSheets-based forum employing the web for the collaborative creation of SimCity™-like interactive simulations. While initially the Behavior Exchange was geared to empower geographically distant users to build and exchange simulation pieces it turned out to be just as useful in facilitating collaboration between kids working in the same class room. Example applications of this technology include the design of sustainable eco systems in life science curricula letting kids create their own animal species and exchanging them via the Behavior Exchange.

Introduction

The web is predominately broadcasting medium of information. However, from the point of view of education it is too passive, as the majority of its users are primarily consumers of information. Becoming an active designer or producer on the web is not trivial. Authoring is usually delegated to HTML literate web-masters that serve as high-tech scribes, in the same way as illiterate people delegated writing to scribes during the Middle Ages. Newer generations of WYSIWYG HTML editors simplify the task of creating static web pages but provide little support for more dynamic content such as simulation and animation. Java allows programmers to include programs into web pages, but to computer end-users this technology remains out of reach.

For end-users to harness the power of the web and be encouraged for more active and productive participation, the image of the web as a broadcast medium should be expanded to include end-user mechanisms in support of collaborative design, construction and learning. This can be done by supporting:

- ***Bi-directional use of the web***: Enable and motivate consumers of information to become producers of resources on the web.
- ***Richness of content***: Make rich and expressive computational artifacts, such as simulation components and behaving agents, utilizing the web as a forum of exchange.

From the educators' perspective, enabling and motivating consumers to become producers of resources on the web and therefore utilizing it as a bi-directional medium for collaborative learning, introduces a more social aspect to the classroom setting, which has traditionally been instructionist [Papert 1993]. With constructionism [Papert 1980], however, an alternative approach to learning has been offered. Constructionism proposes that people best construct new knowledge when they are engaged in personally meaningful tasks. In this spirit, the web needs to become an open medium for active participation in order to become an effective educational medium.

Web content need not be restricted to textual information, pictures and movies, but can include rich and expressive computational artifacts. For instance, the web can become a medium through which users exchange individual components - that we call agents - of SimCity™-like interactive simulations. Such a medium allows users to add their own agents to a community repository. Users need to be able to find relevant agents in the repository and integrate them with their own simulations.

This paper describes the framework that enables and motivates end-users to become producers of computational web artifacts, namely AgentSheets, presents the Behavior Exchange, a web-based forum supporting the social aspects of this process, and describes our experiences with students producing interactive simulations by sharing agents over the web.

End-User Programmable Agents

To empower web users in becoming active producers rather than passive consumers, we have employed the end-user programmable design environment of AgentSheets [Repenning and Sumner 1995], available for Macintoshes. We use the notion of agents as shareable computational units that can be created and exchanged over the web.

AgentSheets is used to create SimCity™-like interactive simulations, domain-oriented visual programming environments, games and infobots. Combined with its novel programming approach, Visual AgenTalk (VAT) [Repenning and Ambach 1996], AgentSheets is a versatile computational medium for a variety of computer end-users ranging from K-12 students to professionals. Over 1000 applications have been created with AgentSheets in areas including education, art, computer science, biology, medicine, and engineering.

Users of AgentSheets create agents for their simulations, by defining both their look and behavior. An agent is given its look by use of simple drawing tools, such as a bitmap editor. The behavior of an agent is defined using VAT, a graphical rule-based language that was specifically designed for computer end-users with no programming experience.

In AgentSheets, agents are autonomous processes able to perceive and act in their environment. An extendible set of sensors allows agents to perceive mouse clicks, sound input, voice commands, keyboard input and even read and parse web pages. Agents can act by moving in a simulation world, changing their appearance, play sounds, speak and open URLs. The mapping between perception and action is determined by the agent's end-user programmable behavior, in the form of IF-THEN rules. A collection of these agents that interact with each other make up an AgentSheets simulation.

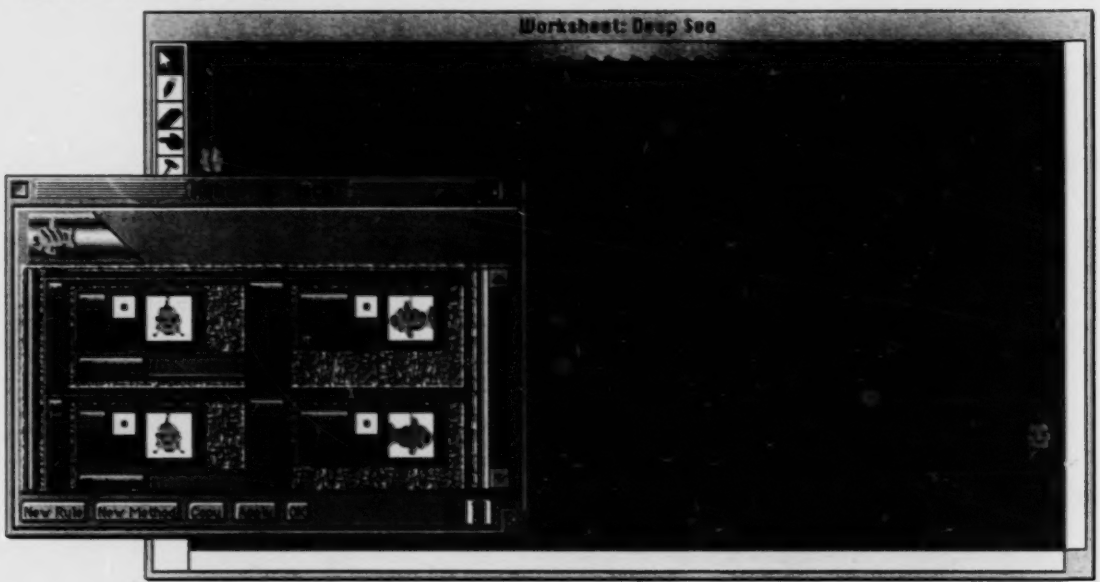

Figure 1: The AgentSheets Environment; Left: Behavior Editor, Right: A fish simulation world..

Figure 1 shows the AgentSheets Fish Tank simulation. The worksheet (window in the back) contains agents representing different types of fish, rocks, divers, air bubbles and water. The Behavior editor (window in the front) contains a Visual AgenTalk program for the yellow fish. The first rule in the window declares that, with a 10% chance, the fish will turn left. Once a simulation is finished, using the Ristretto™ Java generator built into AgentSheets [Repenning and Ioannidou 1997], the complete project can be instantly turned into a Java applet and published on the web.

The goal of this work is to support more directly the requirements of programming in social settings where programming is no longer considered a solitaire activity. In contrast to the original before-and-after graphical rules based language [Bell and Lewis 1993, Furnas 1991, Kirsch 1964] used in AgentSheets [Repenning 1994] and KidSim/Cocoa [Smith, et al. 1994] the new Visual AgenTalk language was designed with web-based collaboration in mind [Repenning and Ambach 1996]. This kind of support requires that computational artifacts can be easily shared [MacLean, et al. 1990], comprehended and modified.

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Agents as Social Currency

The Behavior Exchange [http://www.agentsheets.com/behavior-exchange.html], an evolving web-based information space, allows users to efficiently exchange agents that have been created in AgentSheets through the web. It contains two kinds of information. Informal information is not interpreted by the computer. The look of an agent, e.g., a scuba diver, textual descriptions concerning what the agent does, who created it, why and how it is used belong into the informal information category. Formal information is interpreted by the computer. All the rules that determine the behavior of an agent are considered formal information.

The combination of informal and formal information turns these agents into a social currency of exchange. Users produce agents and share them. Other users pick them up and modify them to better fit into their own environment. There can be a variety of reasons to trade agents. Agents can be complete solutions to problems. For instance, somebody may set up an agent to retrieve weather information from web pages and summarize it in useful ways and place this agent in the Behavior Exchange. Other users may find this functionality useful and wish to download it and use it. Still others may find this agent is a partial solution to their problem and wish to not only download it but to modify it as well and tailor it to fit their needs.

Exchanging Agents: A Scenario

For the Behavior Exchange, the web serves as a medium through which the formal and informal information of agents is exchanged. Collaborative activities include building, sharing, locating, acquiring, comprehending, and modifying agent. These activities are explained in the following sections in form of a scenario.

Building

Bob, is working on a fish tank simulation [Fig. 1]. Bob wants to have a scuba diver that can breathe in this fish tank. He creates a scuba diver and a bubble agent for which he defines two icons using the AgentSheets icon editor. Bob wants the scuba diver to create bubbles when he hits the space bar on the keyboard. Using the behavior editor Bob defines this simple behavior in a single rule [Fig. 2].

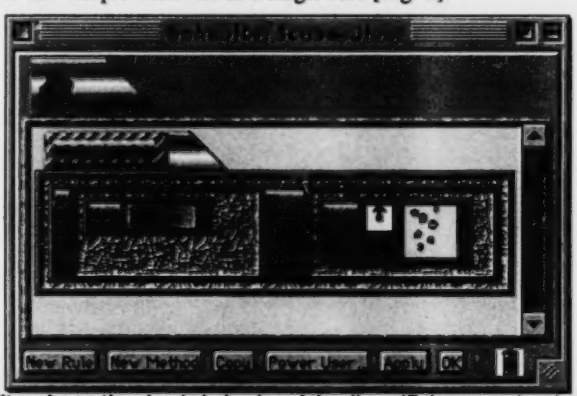

Figure 2. The Behavior Editor shows the simple behavior of the diver: IF the space key is pressed (conditions are on the left) THEN the diver creates a new air bubble (actions are on the right) above itself.

AgentSheets includes a rich set of condition and action commands that can be dragged into IF-THEN rules structures. Considerably more complex behaviors can be built than the one shown including procedural abstractions, numerical operations, colorization [Repenning and Ambach 1996], but a simple example is used to focus on the exchange of agents. Command parameters, e.g., *which key* to test for or *what location* to use to put a new agent, are all defined using direct manipulation. For instance, Bob specifies the key that he wants to use to trigger the bubbles by clicking at the Key condition and pressing the key of his choice on the keyboard.

Sharing

Bob wants to share his scuba diver and bubble agents by submitting them to the Behavior Exchange. Bob simply selects the agents to be shared and annotates each agent with some text explaining what the agents do and how they can be used. This text will be visible to other Behavior Exchange users and will help them to find and use relevant agents.

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Location

Beth visits the Behavior Exchange with the goal in mind to find some new agents for her fish tank (the fish tank comes with the AgentSheets distribution). AgentSheets takes Beth directly to the Behavior Exchange via the web browser [Fig. 3].

Beth has a number of ways to locate interesting agents. She can browse the Behavior Exchange by selecting projects or by selecting categories. Agents can be sorted according to name, date, and creator. Beth, selects the Fish Tank project and browses the agent thumb nails presented to her. She is interested in the scuba diver. Clicking the scuba diver reveals the comments made by Bob about the scuba diver. In this case the comment are quite important since they point out that Beth should also take the bubble agent if she is interested in the scuba diver.

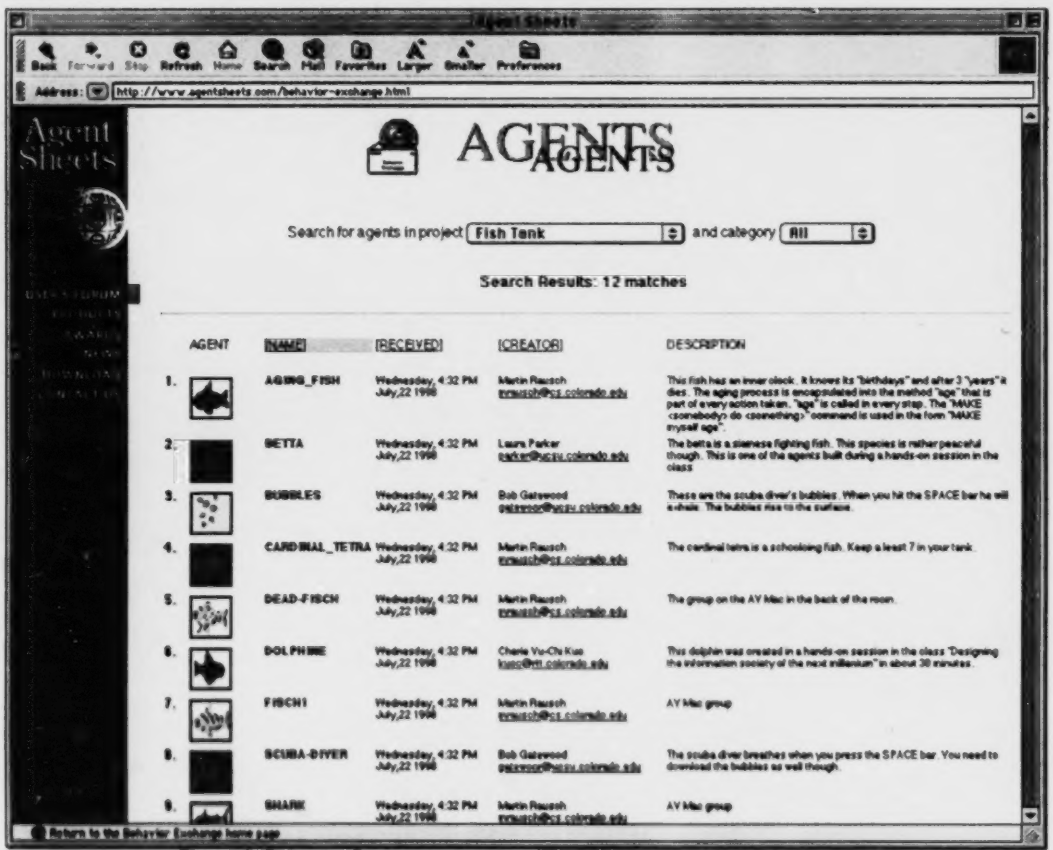

Figure 3. Behavior Exchange showing some agents from the fish tank project.

Acquisition

Beth acquires the scuba diver by simply clicking it in the web page. The scuba diver gets downloaded and automatically added to the AgentSheets agent gallery allowing Beth to put any number of scuba divers into her simulation.

Comprehension

Beth gets full access to the newly acquired agents. She inspects the behavior of the scuba diver agent by opening up its behavior editor. She can test any part of the diver's behavior within her own AgentSheets environment. She can test rules or even individual conditions and actions by simply dragging and dropping them onto a diver, or any other agent, in her worksheet. For instance, when dragging the New action,

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, out of the diver's behavior [Fig. 2] onto a the sea weed, , in the fish tank, a bubble will be created above the sea weed. If the simulation is running the bubble will float onto the surface of the tank and pop.

We believe that the ability to tinker with language pieces without the need to first combine them into complete programs is crucial to the usability of programming approaches for non-programmers. This approach, that we call Tactile Programming [Repenning and Ambach 1996] due to the graspability of language components, supports exploration and significantly simplifies debugging which can be hard in rule based languages [Gilmore, et al. 1995, Rader, et al. 1997].

Modify Agents

After understanding the behavior of the scuba diver, Beth modifies the current divers behavior. She want to have a more autonomous diver creating bubbles without having to press keys and she wants to count the bubbles. She replaces the Key condition with a OnceEvery-n-Seconds condition and adds a Visual AgentTalk formula incrementing the value of a new attribute called "bubbles" [Fig. 4].

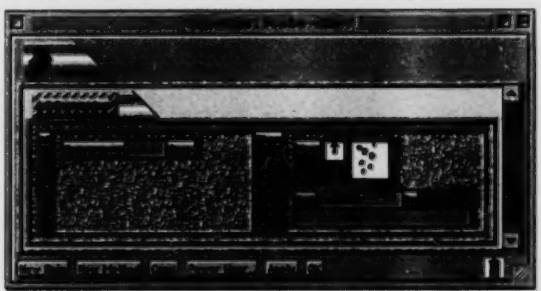

Figure 4. Modified diver behavior creating a new bubble every second and counting the number of bubbles.

The combination of tinkering support with ease of change can overcome some of the fundamental problems encountered in graphical rewrite rule-based systems such as the earliest version of AgentSheets and it's derivative Cocoa. For instance to change a graphical rewrite rule in Cocoa users need to recreate the example situation in which the rule was created. This can be tedious to the point where users resist modification or prefer to create new rules masking old ones instead of modifying the old rule [Rader, et al. 1997].

Experiences and Conclusions

We have gathered experiences in using the Behavior Exchange in elementary, middle and high schools. At a middle school we initially explored design issues and affordances of a web-based exchange forum in a minimally structured school environment. A large group of kids at the Centennial middle school in Boulder meet every Friday at the computer club. The goal of the computer club is to learn about computers in a playful atmosphere. Kids produce drawings, create newspapers and browse the web. One policy of the computer club is that kids are not allowed to play computer games but they are allowed to build their own games. A group of 8 kids designed a game about the Boulder walking mall. The game featured a tourist as the main character. The tourist had some money to buy gifts in a variety of shops or to support artistic presentations such as jugglers. The objective of the game was that the tourist successfully walks from one side of the mall to the other buying things but at the same time avoiding obstacles such a muggers and other game characters. In the process of building the game the Behavior Exchange allowed subgroups to develop their own characters and share them with the entire group.

In an elementary school the Behavior Exchange was used to facilitate collaborative eco system design. Under the direction of Clayton Lewis this project explored the suitability of simulation building as a means to science education. This activity was part of the regular life science curriculum. Instead of just studying food webs the traditional way the kids had to design their own species (animal or plant) using AgentSheets. The species created by individual kids were combined into complete eco systems. Supported by worksheets the kids explored the sustainability of their food webs in action. Quickly they were able to determine if they had a sustainable environment or if their species needed further adjustments.

In a high school the Behavior Exchange was used as reuse mechanisms. In a course titled "Exposing the Human Grotesque" a social science teacher and her students built an interactive city including a character that can be walked through the city to find stories of people and buildings. The Behavior Exchange served the role

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as a repository of city design components. Using existing agents such as roads, trains, and cars the kids, mostly with psychology and literature backgrounds, got their city off the ground very quickly.

While initially the Behavior Exchange was geared to empower geographically distant users to build and exchange simulation pieces it turned out to be just as useful in facilitating collaboration between kids working in the same class room possibly right next to each other. Often when thinking about web-based collaboration support one tends to think about communication between spatially distant members of a virtual community. We found that networked school computers, while satisfactorily connected to the outside world, provide little if any support for local collaborations. Partly this is because of safety concerns found in many schools. Freely exchanged floppies or application programs downloaded from the web can be the sources of devastating viruses. The Behavior Exchange supports collaboration in local communities without the need to disable virus checking or to add extra infrastructure.

The work presented in this paper is only a first step towards the reconceptualization of the kind of information distributed through the web. Our experiences with students using AgentSheets and the Behavior Exchange suggests that using agents as social currency enables and motivates end-users to become more active participants in the evolution of the web. This shift transforms the web from an information broadcast medium to a medium for collaborative design and learning. Such a medium supports discussions and collaborative learning through the sharing of ideas and artifacts. AgentSheets can be downloaded at http://www.agentsheets.com

Acknowledgments

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Electronic Communities of Adult Learners: Identifying the Requirements

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Abstract: This paper discusses a number of issues which affect the use of information technology to build learning communities. It refers particularly to learning among adults, and surveys some of the key factors which need to be taken into account in producing a framework for analysis. It reflects work in progress and so the final framework has not yet been determined.

Electronic Communities of Adult Learners: Identifying the Requirements

Background

This paper discusses how a set of requirements can be defined, for new technology to be used to build up electronic learning communities for adults. It focuses on the needs of students with some business experience, and on the possibilities for interactive discussions, predominantly using Internet tools.

Technology and Applications

One widely-used technology for electronic discussions is that of Usenet newsgroups. Jones (1997) has studied the dynamics of one such group, and raised some interesting effects. Two points which are relevant in this analysis are:

- The importance of *context*, represented in this example by the use of information sources elsewhere on the Internet to inform discussion within a particular group
- The existence of some very long and involved *threads*, showing that participants were responding to, and debating with, points raised by others.

Jones chose a group whose subject was particularly topical at the time, and whose participants were particularly interested.

In the context of formal education, electronic communities are usually associated with distance learning. However there is some evidence for their relevance in other learning environments as well. Ruggles, Underwood and Walker (1995) described a project that set out to create a tool kit useful to distance learning and campus-based students alike. The primary mode of instruction was just one of many variables influencing how this toolkit might be used. Hacker et al (1996) describe a mailing list which allowed campus-based students in different parts of the world to communicate with colleagues elsewhere, and the MBA students mentioned later in this paper took part in this exercise. Austin (1997) suggests that electronic communication is particularly valuable in encouraging people to engage in discussions where there are very contentious issues and entrenched opinions. Selinger (1998) placed her research in an environment where student teachers were practising their skills in the classroom. She identified electronic communication as being important to provide support in this environment. So one element in identifying the requirements is to identify a fit between the technology and the mode of instruction.

Research issues

Paccagnella (1997) examines some alternative approaches to qualitative research on electronic communities, and focuses on the idea that these are similar, and subject to the same research considerations, as any other type of community. Mitchell (1997) describes much educational technology as being 'on the wave of pseudo science', and particularly strongly criticises much educational research. But within this criticism there is an encouragement of qualitative research, and of approaches which generate results which can be replicated.

Tapscott (1997) writes about the emergence of a generation of children who are so familiar with information technology, that they will adapt to its use in new ways. But anecdotal evidence from use of the Internet suggests that it is popular with people of all ages. Among Usenet groups there are several where the

In particular there is a trend in the workplace towards the use of new technology, and a result of this is that familiarity with computers can be expected of most office workers. Analogous to Tapscott's digital generation or 'N-generation', is a generation which has entered employment since personal computers have been widely used. The extent to which adult learners have grown up with computers *in their working lives* is a factor which can affect learning styles

Conversely there is a huge step between the stand-alone PCs which were important in business in the late 1980s, and the current PC connected to the Internet. There is an analogy with the transition from broadcast-only television to the wide use of video recorders, which transformed the way that television could be used during the late 1970s and 1980s.. Pincas (1998) has linked the emergence and availability of new technology to the opportunities now existent for lifelong learning.

There are many ways of structuring information on the Internet, and other electronic media. The Internet is usually associated with a hypertext approach, but excessive use of hypertext can detract from the ability of information to tell a story. Gartner, Latham and Merritt (1996) describe the importance of storytelling in education. In the business context, Watson, Akselsen and Pitt (1998) allude to the difficulty of creating material which effectively engages the browser, in an increasingly densely populated world wide web.

Cohen (1998) looks at the rôle of fiction in educating managers. Her perspective is relevant because it brings in issues of context, because the fiction needs to be placed in a context which is appropriate to the managers' learning, and again of storytelling as a way of conveying a set of ideas.

Winograd and Flores (1986) propose a framework which has since been used for discourse analysis. Experience shows that their work is a valuable starting point but that attempts to carry out detailed analysis of an electronic discussion can be limited by difficulties in choosing appropriate classifications, and in dealing with potentially large volumes of data. Also this approach is only relevant to computer conferencing and discussion systems, and there are many other ways in which information technology can be used to assist in learning.

These references point to a need for a qualitative framework which takes into account:

- The context in which electronic media can be used to set up discussions
- The learning objectives that are to be achieved
- The extent to which students are encouraged to engage in discussion and debate with one another, and not just to propose ideas which might be ignored
- The potential for interaction with other approaches to learning, including conventional face-to-face tuition
- The technological maturity of the students - in terms of the sort of systems that they feel comfortable using and in terms of their own expectations from a learning environment.

Students' experiences

This research is based on discussions with postgraduate students on their use of technology in learning. Two particular groups that are of interest are:

- MBA students who have significant business experience before taking a full-time MBA
- Part-time masters students whose postgraduate study is focused on learning about teaching and learning techniques

Preliminary results reinforce the importance of building up a critical mass of activity within a virtual community, and also the need for some sort of structure around any discussions.

Among the MBA group there is a particular concern raised by students after the first 4-6 weeks of the one year course. Issues raised by students face-to-face, in meetings with staff and in tutorial sessions, included:

- Difficulties in accommodating the variation of backgrounds and abilities among the group of students
- Difficulties in identifying practical business applications for the theoretical issues being discussed.

A formal evaluation using student questionnaires was carried out later in the course, but these issues were barely mentioned. When the topic was pursued with the students, they suggested that the issues mentioned above were no longer topics for active debate, as they had been raised in earlier meetings. This is consistent with Mitchell's idea that qualitative research is more valuable than quantitative in such areas; the student questionnaires would have been more amenable to quantitative research than the earlier discussions but would not have emphasised the most important issues.

These issues raised early in the course, again, are to do with context and with the nature of the student cohort, so they support the importance of these in a framework for analysis.

Among the part-time masters students there were different concerns. Because most of them are already interested in approaches to instruction, they are very interested in using a wide range of sources and influences, and in building an approach to education which encourages reflection in the style advocated by Schön (1987). They viewed practical experience of using technology as an element in this – and were disappointed on occasions when the conferencing technology being used was not sufficiently robust for the students to carry out all the planned exercises.

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Developing Hypertexts through a Self-Organizing Map

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Abstract: *An interesting application of the Self Organizing Map (SOM) network, a neural network widely used to organize multi-dimensional data, is the organization of collections of documents in maps that display relations between the content of the documents. In this work it is shown how this feature can be used to support the development of hypertexts. A hypertext author has to manage all the information contained in hypertext nodes and build a link structure that represents the semantic relations between information nodes. An SOM network can create an "information map" that can be used to organize a whole collection of documents according to the hypertext paradigm. In this work information maps are produced starting from existing hypertexts and the semantic organizations developed by the neural network are compared to the original organizations of the hypertexts. From the results of these comparisons we have developed a system which organizes large amounts of documents in such a way to allow users to have access to them with hypertext features.*

1. Introduction

The human mind stores, manipulates and recalls information using an association mechanism. When we try to memorize something, the best way to do that is to link the new pieces of information to something already known.
When an author tries to organize a set of information in a book or a paper, he is forced by the linear structure of the medium to find a sequential order and put the information on paper. The reader has to read the book or paper and re-link together the pieces of information in it to rebuild the knowledge representation; moreover he has to link this information to existing knowledge [Ginige A., Lowe D.B., Robertson J. 1995] .
Hypertext and hypermedia give us the technology to mimic this process. Using hypertexts, the author can show more than a set of information; he can show the conceptual associations between information atoms, using the link structure to represent semantic relationships between nodes [Botafogo R., Rivlin E., Shneiderman B. 1992].
In developing hypertexts two different phases can be distinguished: authoring and publishing. The authoring phase involves creating and storing information; it also involves identifying structure for the information that supports appropriate accessibility and manipulation. Publishing involves the process of presenting the information to the user, including issues like interface development, layout etc.
To author a hypertext system three main approaches can be identified:

- programming language based approach
- screen based approach
- information centered based approach

In programming language based approach hypertext applications are coded using scripting or computer programming languages such as C.
In screen based approach, typical of many authoring environments, every screen tends to contain an information atom and is linked to other screens to build the hypertext application.
In information centered approach, the content is obtained from existing information; this information is divided into atoms by identifying key concepts and stored in a sort of database. An example of information based hypertext system is the World Wide Web.
Large hypertext systems cannot be afforded using the programming language approach, because it is a low level approach, or the screen based approach because it is strongly based on user interactions and visual programming; these two approaches are suitable for handcrafted small or medium systems. On the contrary, the information centered approach allows authors to separate structuring information from linking and interface building.
Structuring information involves generating information atoms by breaking down the information or documents.

In this phase information retrieval algorithms allow the production of key phrases useful in identifying the linking point between information atoms; however this approach could miss relevant key phrases or create irrelevant ones.
Linking information involves a mental management of all existing nodes in the information set. If the set of nodes is small the author can remember the associated information and create the links. When the information space is large (more than 500 nodes) it becomes impossible to remember the information contained in all nodes.

2. The Self Organizing Map

Artificial neural network models are often based on our present understanding of biological nervous systems. All these models are made by a dense interconnection of simple non linear computational elements corresponding to the biological neurons. Each connection is characterized by a variable weight that is adjusted during the so-called "learning stage".
The Self-Organizing Feature Map (SOM) [Kohonen T. 1995] is a neural network, discovered by Kohonen, that during the learning stage tries to build a representation of some features of input vectors. This behavior is typical of some areas of the brain where the placement of neurons is sorted and it often reflects some features of sensorial inputs.
In the SOM neurons are organized in a lattice, usually one or two dimensional array, that is placed in the input space and is spanned over the input vectors distribution. During the learning stage the neural network can cluster the input vectors. Using a two dimensional SOM network it is possible to obtain a map of input space where closeness between units in the map represents closeness of clusters of input vectors.
The number of neurons in the array does not depend on the dimension of the input space, however a small number of neurons may cause a coarse clustering. The SOM algorithm operates a classification where the distance between neurons represents the distance between two clusters of vectors in the input space.

3. Organizing documents using SOM

Using a convenient document representation it is possible to use a SOM network to produce an ordered document map in which a user can navigate and find the right document using explorative search [Kaski S., Honkela T., Lagus K., Kohonen T. 1996] , [Honkela, T., Kaski S., Lagus K., and Kohonen T. 1996]. In these works, two SOM networks have been used: the first SOM is a semantic SOM, the so-called "word category map", used to organize and classify all the words used in the set of documents; this SOM network produces a document representation, or document encoding, which is useful in characterizing it. The second SOM organizes these document representations in such a way as to create the document map.
Recently it was shown that a simple document representation using well known practices in information retrieval could produce the same or better results [Kaski S. 1997]. In this work the vector space information paradigm, a standard practice in information retrieval (IR), it is used to encode the document set and train the document map .

3.1 Representation of the documents using the word category map

The word category map organizes the words in a two-dimensional array by semantic categories and every unit can be labeled using a word or a set of words. The similarity between the categories created during the self organization phase is reflected in their distance relationships on the network array [Ritter H., Kohonen T. 1989], so synonym terms, or terms which occur in the same context, label the same units or units close together. "Stop words", like articles, and words that occur less than N times (rare words) are neglected to reduce the word number.
The word category map is trained by using vectors built according to the theorem in appendix I of [Ritter H., Kohonen T. 1989] where it is also possible to see an example of word category map and the construction of its training vectors.
In these experiences, the word category map is used to produce a document representation called "document fingerprint", [Honkela, T., Kaski S., Lagus K., and Kohonen T. 1996], a two dimensional histogram obtained by mapping every document on the word category map. This histogram is "blurred" using a Gaussian convolution

kernel to reduce its sensitivity to small variations in the document. A fingerprint for every document in the document set can be obtained, and this set of fingerprints can be used to train the second SOM network, the document map. After the training stage this SOM network can be labeled using the document titles and used for "navigating" or browsing through the document set.

3.2 Documents representation using the vector space information paradigm

Assuming a dictionary vector D, where each element is a word *di*, each document can be represented as a vector V where the element *vi* is the weight of the word *di* for that document. The word weight can be calculated using the Term Frequency * Inverse Document Frequency (TFIDF) scheme which calculates the "interestingness" value of the word. If the document does not contain this word then $vi = 0$. Assuming a collection of documents B, in the simplest case the weight *vi* of a word *di* in a document T is given by:

1) $$v_i = tf(i)\log\frac{n}{df(i)}$$

where *tf(i)* is the number of times *di* appears in T (term frequency), *df(i)* is the number of documents in B which contain *di* (document frequency), *n* is the number of documents in B. It is possible to note that the *vi* value will be low if *df(i)* will be near *n*, meaning that the word is common in the document collection. On the converse if a word identifies a subset of documents (i.e. is contained only in few documents) *df(i)* will be low and the *vi* value of the word will be high. In [Balabanovic M., Shoham Y. 1995] it is possible to find another formula to calculate word weight that is an improvement of (1); this formula allows the normalization of the vectors used in this work to train the SOM network to create the information map.
This approach allows a faster calculation of the document representation than the one obtained by using the word category map.

4. The SOM network to map the information space

Using a SOM network it is possible to build an information map on the information space constituted by a document set. It is possible to use this ordered map in two ways: to support the hypertext development and to give an hypertext-like access to a knoledge base.
A hypertext author has to know all the documents in the information space to build a coherent link structure. However, as already said, this can be an incredible overload if the information space is large, so ordering information using a semantic criterion can be extremely useful. By using an SOM network it is possible to find a semantic order in the information space and build an information map which is useful for supporting the hypertext developer. In this information map, related atoms will be placed near each other and the author will not have to browse all the information space to create a link, but he can search only the neighboring area.
Moreover, if a large document set is available, it is possible to use the information map builded by the SOM network to allow an effective access to the information, by means of a hypertext feature.

4.1 An information map example

As already said, links in a hypertext represent a semantic structure on the information space; if an information map is created by using nodes of an existing hypertext, it is possible to assume that the information map will reflect this semantic order in some way. In other words, it is possible to think that directly linked information in existing hypertexts will be in the same place or near each other in the information map, and so it is possible to compare the link structure built by the developer to the node organization imposed by the neural network.

FIGURE MISSING IN COPY RECEIVED BY ERIC.

Fig. 1 Section of the information map HTML page.

One of the hypertexts used is a web course on hypermedia and hypertext, and is on Internet at http://wwwis.win.tue.nl/2L670/course.zip. This hypertext consists of 162 nodes and 357 links. The vocabulary consists of about 6500 words; however only 600 words are used to build the document representation vector for each node; these words have been obtained by ignoring stopwords (like articles), non-significant words (like nouns, auxiliary verbs, etc.), and rare words. The training set is made up of 162 vectors of 600 real components; the SOM network is a 5 x 8 lattice and the simulation has been carried out using the SOM_PAK 3.1 simulator. The obtained information map is converted in the HTML page shown in fig 1, to assist hypertext navigation. In fig. 1 each neural unit is represented as a box in a 5x8 HTML table that contains one or more hypertext nodes that are semantically related to each other (it really contains a link to the HTML file), and some keywords (in bold print) that are generated by taking the six largest vector components of each neural unit. These keywords can give an indication of the kind of documents contained in each box and can help to label some areas in the information map.
It has been found that 80 links are between nodes that are on the same place on the information map (the same neural unit), and 151 links are between adjacent nodes in the array, so 231 links (64.7 % of the total link number) are made between information atoms near each other in the information map. But it has to be said that the information map cannot reproduce a hierarchical structure, which is common in hypertext, so that index nodes can generate links that cross the whole information map.

4.2 Hypertext access to the knowledge base

The statistical data reported in the previous section indicate that, in our experience where we took in account large amounts of documents on the same topic or similar subjects, about the 65 % of related documents are close together in the information map. Starting from this result, we have designed and developed a system which allows an effective access to the knowledge base, by giving it a hypertext feature.
In order to design this system, we have afforded two specific problems:

- To allow users to navigate from a specific document to the related ones;
- To identify the most appropriate documents to become access points to the whole knowledge base.

As far as the first problem is concerned, the developed system shows the content of a specific document together with the references to the neighboring documents in the map, whose content is actually related to the shown document (fig. 2).
Specifically the system shows, in the frame in the right-hand side of the window, references to the 10 documents nearest in the map; anyway, users can ask for more links to further documents. These references are sorted by decreasing distances from the document whose content is shown in the left-hand side of the window, and are

grouped according to the clusters the pointed documents belong to; the keywords identifying each cluster are shown before each group of references, and the most representative keywords are in bold print.
As far as the second aspect is concerned (i.e. identifying the documents which can be used as access points to the whole knowledge base), the adopted solution consists in an automatic selection of a limited number of access points (10 documents for a 40 cells map) performed by the system. By starting from these documents, called master documents, and following the links, the user will be able to navigate through the whole knowledge base. In order to identify the master documents, the system selects the documents nearest to each neuron in the neural network. Actually, by considering each neuron as the center of a cluster of documents, the most representative document of the cluster is the one closest to the neuron.

FIGURE MISSING IN COPY RECEIVED BY ERIC

Fig. 2 A document and links to its related documents .

Nevertheless, since in this way we would get a big number of documents, especially for very wide hypertexts (in the shown example we would obtain 40 master documents), it is more effective to repeat the classification through a second SOM network. This network, smaller than the first one, does not classify directly the documents, but the clusters gotten from the first neural network. In such a way we obtain a two levels neural architecture: the first level is carries out the information map; the upper level classifies the clusters obtained from the first level.
The master documents are obtained , at this point, by extracting the documents nearest to the neurons of the second level SOM. By means of the master documents, users can actually have access to several points of the information map, that is they can have access to specific areas of the knowledge base.
An alternative solution to select master documents, foresees the intervention of an expert of the specific topic to create or point out introductory documents about the main hypertext subjects.
Furthermore, the information map is always available to the users thus allowing them both to have a complete view of the whole set of documents and to select directly documents starting from their keywords.

5. Conclusions

Self-Organizing Maps are useful tools to organize a set of documents and to create a map that facilitates interactive browsing and document searching. Documents are classified, according to their content, in clusters corresponding to the cells of the map. Moreover the SOMs generate some keywords from the information atoms to label the map cells.
Information maps on existing hypertexts have been created, and the comparison with the link structures has shown that related documents in hypertexts are often close together in the information map. However it should be noted that some hypertext structures (i.e. hierarchical structures) cannot be reproduced using information maps.

In this paper we have reported on a system based on two levels SOM architecture which provides users with a hypertext access to large sets of documents on a specific topic. An interesting application of this system is to organize a large amount of documents downloaded from the net.

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EDGES Server: developing an Educational Distributed Agent System

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Abstract: Using a search engine to retrieve information on the Web can be a frustrating experience for the novice user: keyword search and boolean logic is not natural and the ranking criteria of many search engines produce counter-intuitive results. In this paper we propose the EDGES system: a distributed agent system that allows the user to access document collections on specific topics and to filter the documents obtained using a search engine. The system is based on the vector space model for information retrieval and uses a SOM neural network to map the information space constituted by the document collections and to filter the documents retrieved from the Web.

1. Introduction

According to [Gudivada V., Raghavan V., et al. 1997] the Web is the largest distributed digital information space, it includes 150 million pages and this number doubles every four months. While surfing this information space can be easy and fun, searching for information in the Web can be a frustrating experience. Search engines like AltaVista can be difficult to little experienced users that have to translate the query into a set of keywords linked through boolean operators. Moreover search engines rank the query results using criteria that can produce counter-intuitive results (for example using the frequency of query terms) and force the user to scan almost all the documents retrieved. Conversely the vector space model of information retrieval allows the formulation of a query in natural language (not only a list of keywords) and a user can give more weight to a word by repeating it in the query and adding more words related to it. This information retrieval model is based on the premises that both a set of documents and the user queries can be represented using n-dimensional vectors [Balabanovic M. and Shoham Y. 1995]. A document is represented by a vector in which each term corresponds to a word and its value is the weight of the word in the document calculated through the frequency of the word in the document. By using the vector space model the matching strategy is based on the euclidean distance, or on the cosine method: a document is more relevant with respect to a given query if its vector is closer to the vector representing the query, so that the ranking of documents is meaningful.

2. Using a Neural Network to Map the Information Space

The Self-Organising Map neural network (SOM network) can create a map that organises a set of documents in a two-dimensional array [Kaski S., Honkela T. et al., 1996] using the vector space representation. This array can be considered as a bookshelf where documents are semantically ordered, in such a way that documents on related topics are close to each other on the bookshelf. It is also possible to generate a list of keywords that label each place on the bookshelf as well as clusters of documents. In fig.1 the bookshelf built by the neural network is shown; the enlarged section (upper right) shows two clusters of documents and the keywords associated to each cluster. The SOM network can also be used to filter documents obtained by a user query. As already said it is possible to represent a query through a vector which is placed in the appropriate place on the bookshelf by the SOM network, thus relating - in a semantic way - the user query to a specific cluster of documents. Moreover if a user gets a set of documents by AltaVista, it is possible to use the SOM network to find their right places in the bookshelf and rank the retrieved documents according to their distance from the query. As an example, in fig. 1 the document number 1 retrieved by AltaVista will be ranked as relevant but the document number 2 will be considered not relevant.

3. The EDGES System

The aim of the EDGES project is to build a set of servers that allow the user to access information on a specific topic, to filter the documents obtained using a search engine and to build a document database, using an agent based computer interface. The system is based on the vector space model for information retrieval and uses a

SOM neural network to map the information space constituted by the collection of documents. A set of agents allows the user to query this structure and to use the knowledge stored in the neural network in order to filter the documents retrieved by a search engine. The system is under development using java and aglets technology [Danny B. Lange and Mitsuru Oshima, 1997].

The EDGES system is composed of servers that contain the following components:

- *A set of master agents,* one for each user. A master agent helps its user to obtain the required information: it gets the query from the user and create the search agent to look for the desired information in other EDGES servers; moreover, the master agent can create the user interface and present the search results to the user. On user demand, it can query the Web using AltaVista or other search engines and distribute the search results to the specialized agents for filtering.
- *Search agents*, dynamically created by the master agents; they deliver the user query to the EDGES servers. They also deliver the URL of documents to be filtered.
- *A set of specialized agents*, one for each topic. A specialized agent manages a document database through a neural network. It answers to the query carried by a search agent finding the best matches to the query and proposing them to the user, together with a set of keywords and some annotations if available. Periodically, the specialized agent re-organises the database and repeats the learning stage of the neural network. Finally, by using the neural network, it can filter the documents proposed by AltaVista and propose only the best matches to the query.
- *A directory of other available EDGES servers*, used by the master agents and the search agents to know the addresses of the other EDGES servers.

If a user wishes to retrieve information on a particular topic, s/he can ask to her/his master agent to search this information. The master agent does not have to know where the fittest specialised agent is, since it passes the query to the local specialised agent and wait for an answer. If no one of the local agents can satisfy the query (i.e. no one of the local specialised agents knows the query topic), the master agent forwards the query to the other EDGES servers on the directory using search agents. When each search agent reaches a new EDGES server, it sends the user request to the local specialised agents and wait for the answer. If a specialised agent can satisfy the request, it sends the URL of the best-matched documents back to the search agent that, in turn will return them to the master agent. If the specialised agent cannot satisfy the request, the search agent will read the local directory of other EDGES servers, will clone itself to reach the servers not yet visited and will die. The master agent will show the answers of the specialised agents to the user and can query AltaVista if the user wants it. The URLs returned by AltaVista can be filtered using the user query and the knowledge of the right specialised agent.

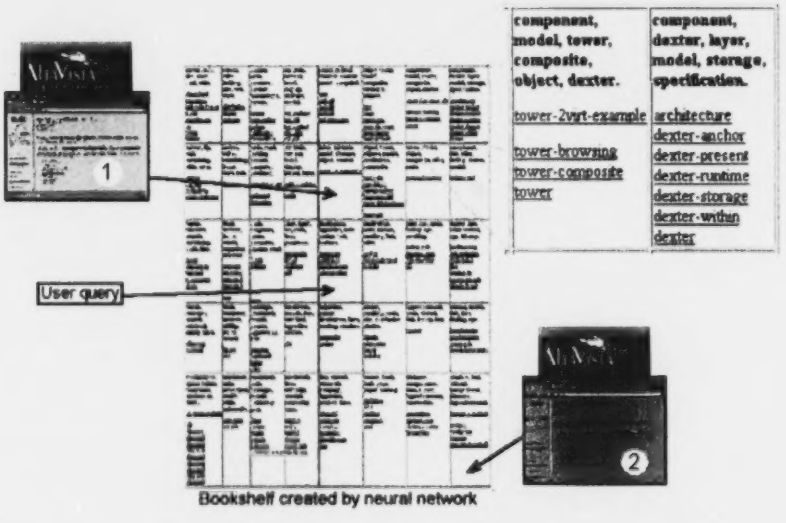

Fig. 1: The bookshelf built by the neural network

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NeuroNames and The Template Atlas

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Abstract: The information explosion in neuroscience has been limited in its application by the lack of a complete, unambiguous description of the brain suitable for computerized database management. This demonstration begins with an introduction to the NeuroNames Brain Hierarchy: the first comprehensive attempt to standardize human and non-human primate neuroanatomical terminology sufficiently for use in computerized applications. A discussion is provided of the Template Atlas - a set of 63 stereotaxic drawings based on cortical views and coronal sections of the brain of the long-tailed macaque (Macaca fascicularis). The Hierarchy and Atlas have been incorporated into a web site representing neuroanatomical structures both verbally (by name) and visually (by image). This site is demonstrated, and freely accessible for noncommercial use (http://rprcsgi.rprc.washington.edu/neuronames/index.html). Its success warrants further inclusion in neuroanatomical research and teaching. Opportunities are discussed in the context of a more extensive Brain Information Management Project.

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Virtual Class: Distance Learning for Small and Medium Sized Enterprises in the Spanish Region of Castilla y León

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Abstract: Long-life learning arises as a new necessity in the new Information Society, where everyone, but especially Small and Medium Sized Enterprises (SMEs) workers, have to catch up with the new technologies continuously. Therefore, education and training are of the most importance in this updating. Research Work Group *Canalejas*, has developed a multimedia educational CD-ROM titled "Basic Course on Telecommunications for Small and Medium Sized Enterprises", mainly addressed to SMEs training. This paper describes the technical and educational issues addressed by the project of developing a multimedia educational CD-ROM.

1. Objectives and Presentation of the Work Group

The aim of this paper is the presentation and description of our approach to a multimedia educational CD-ROM titled "Basic Course on Telecommunications for Small and Medium Sized Enterprises ". It includes a distance learning environment called *Virtual Class* and some interactive multimedia courses on "telecommunication services". Virtual Class is based on the use of telematics networks, what makes possible the interaction between teachers and pupils. It is a server-client application, which uses the Internet protocols. Both the client side and the courses are distributed on the CD-ROM.

The CD-ROM is the result of the coordinated action among different kind of specialists, mainly Pedagogues and Telecommunication Engineers, implemented in a Research Work Group called "*Canalejas*". The research

of this interdisciplinary and inter-university group is focused on "Educational Multimedia and Telematics Networks in an Educational Context", evaluating the possibilities and advantages of applying Information and Communication Technologies (ICTs) to the learning process. Canalejas Work Group is integrated within CEDETEL (Center for the Development of the Telecommunications in Castilla y León), a Technological Center that has leading Small and Medium Enterprises into the Information Society as one of its main objectives.

The CD-ROM is primarily addressed to SMEs' employers and employees, although it will be subsequently extended to cover other segments. It has been evaluated in a course offered to SMEs in Cedetel during September-October of 1997 and we will have the opportunity of evaluate it again in two incoming projects: a course about Distance Learning for future teachers at the University of Salamanca and a course for physical disabled people within an ISPO (Information Society and Project Office) European Community initiative. The last project aims at raising awareness about the possibilities of distance learning and teleworking in people with disabilities.

2. Educating for the Information Society: Long-Life Learning

We are now living a historical period of technological change; we are living the evolution towards an Information Society . But citizens are not prepared for the new society yet. As a matter of fact, our countries' educational systems are designed to satisfy the needs of an industrial society, not to the ones of an information society [Tiffin and Rajasingham 1997]. People have to be trained in the use of new technologies and familiarize themselves with them; and ICTs have to be introduced into our educational systems, at all levels. All over the world raises the demand for more training. The future of a country does not depend on its natural resources anymore, but in the capability of its population, that is, in the education they receive.

In the ancient Greece, the twenty-first years constituted a training period for the adulthood. And this educational tradition has had an intense influence in the occidental educational systems, but this idea is changing and the training process has begun to be considered as an activity that lasts a lifetime. With the emergence of the Information Society, everyone must upgrade their skills constantly and obtain new qualifications. And this acquiring of new aptitudes and abilities should therefore no longer be limited to formal schooling (primary, secondary and higher education), but should involve all sections of society: youngsters, middle-aged and older people; people at all levels of vocational qualification; people in work and the unemployed [Delors 1996].

In an especial way, this long life learning will affect SMEs, due to the job transformation process. The introduction of ICTs together with organizational changes is affecting employment in demand for more and broader skills and for fewer unskilled people. Remaining competitive SMEs increasingly depends on their capacity to absorb and use new technologies, and to have access to knowledge. SMEs must face these challenges, introducing themselves into the Information Society and making use of the tools and services it provides.

Education and training will play a central role in the advance towards an information society, which will be a learning society, as asserts the White Paper on Education and Learning of the European Commission [European Commission 1995].

3. New Telematics Technologies: Distance Learning

Regarding the needs of long-life learning for all sections of society, access should be ensured to everybody. At this point, ICTs, and particularly telematics networks, are going to play a very important role, not only as a training content, but also as a mean to supply the training itself.

The telematics networks, in an educational context, create a new learning environment, in which teachers and pupils do not have to coincide in space or time, making learning more accessible. We can make use of the term distance learning, which has the following advantages:

- Distance learning is very flexible, since it makes the learning process independent from space or time.

- Being independent from space lets students learn where they want. This means distance learning can attend people living in rural or peripheral areas and people with physical disabilities.
- Being independent from time lets students learn when they want, at their own pace.

- It is more constructive, since students reach knowledge through an active learning process; teachers become a background guide, while pupils play the main role.
- It is more appropriate during adulthood. Adults have a record of educational experiences and can make the most of the learning process by their own. Besides, they feel better attending distance learning than going back to a classroom.
- It can be cheaper than traditional learning, once the initial investment is exceeded. This fact is especially important in SMEs, which do not usually invest in long-life learning.

All these features make Distance Learning suitable for training SMEs' employers and employees.

4. CD-ROM "Basic Course on Telecommunications for Small and Medium Sized Enterprises"

Our labor and efforts to provide SMEs with a training tool suitable to their needs have result in the publishing of the CD-ROM "Basic Course on Telecommunications for Small and Medium Sized Enterprises".
The CD-ROM includes a distance learning environment, called Virtual Class, and some courses on Internet and its Tools and Telecommunication Services. These courses run within the Virtual Class environment. They are mainly addressed to SMEs' employers and employees, although they can be extended to other adult segments who have not previous knowledge of the contents.
In the CD-ROM development process took part a regional-wide-scale enterprise named Divisa Informática, S.A., which is at the same time partner of CEDETEL. They took on the distance learning environment development. As for the courses, the work group from the University of Valladolid (Telecommunication Engineers) assumed the tasks of programming and production, while the work group from the University of Salamanca (Pedagogues) undertook the structuring and presentation of the contents. The audio production was carried out by *Audio-visual Media and New Technologies Service*, from the University of Valladolid.
The CD-ROM is designed for Windows 95 and the PC requires this minimum hardware configuration:

* CD-ROM drive
* Pentium/90 MHz microprocessor
* 16 MB of random access memory (RAM)
* 3 Mbytes of free hard disk (HD) space
* Sound card
* Graphics adapter card capable of displaying 16 bit color at 800x600 pixel resolution

4.1. The Distance Learning Environment

Virtual Class is a distance learning environment for giving and receiving distance courses, with the aid of telematics networks, that can be accessed through services like INTERNET or INFOVÍA [1], as it uses the Internet Protocols. It is a client-server system; the server is located at Divisa Informática (e-mail, news, web and data base servers), while the client is distributed in the CD-ROM.

[1] INFOVÍA is a public service offered by Telefónica since December 1995 and gives access to INTERNET/INTRANET networks from any point with telephone connection, in the whole Spanish country. The cost of the service is the cost of a metropolitan telephone call.

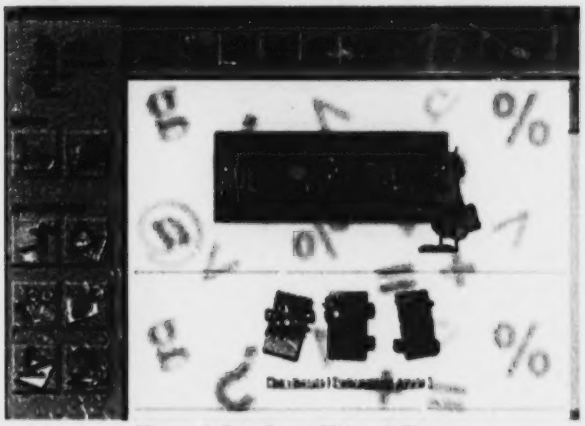

Figure 1. Interface of Virtual Class

One of the main drawbacks of distance learning has been the lack of opportunities of interaction between teacher and pupils. Therefore interaction and feedback have to be improved, and suitable tools have to be provided to ensure them. But both teachers and students have to become aware of the new patterns of communication and become comfortable and familiar with them. They also have to be prepared to resolve the technical problems they may come across. In Virtual Class, teachers and students can make use of e-mail and news to communicate. Teachers can also publish events, related to a specific course.
Besides the communication tools there are other ones that let the student examine the contents of the courses, check bibliography or view other students; and the teacher manage the course (add new students to their course, supervise their accesses, add new bibliography...). All the tools are fully integrated into the Virtual Class environment [Hernández et al. 1997].

4.2. The Multimedia Courses: the Development Process

Besides the interface *Virtual Class*, the CD-ROM includes some multimedia courses on Internet and its tools (World Wide Web, Electronic Mail, Telnet, ...) and telematics services. These courses run within Virtual Class, so the tools it provides can be used all together.

Figure 2. Sleeve of the Course *Internet*

The courses have been developed with Toolbook Instructor II, an authoring system for Microsoft Windows. Toolbook is an object-oriented development environment that provides drawing tools for creating objects and a full-featured programming language, called OpenScript, for programming object behavior.

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Authoring languages are supposed to be easy to use in order to let people who are not familiarized with programming design create their own titles. The lack of suitable tools is the main reason for not introducing Information Technologies in the learning process. In this way, if the teachers create their own programs, they can adapt them to their students' needs.

The result of our experience has not only been the development of some courses, but also, the outlining of a methodology, that identifies the steps involved in managing a multimedia project:

1. Planning the project. Before starting developing a title, we should think through every aspect of the project. At this point, we must specify:
    A. Content: Internet and its Tools and Telecommunication Services
    B. Audience: SMEs employers and employees, although extensible to other adult segments, having no previous knowledge of the contents of the courses.
2. Prototyping the title. Audiences respond strongly to how a title looks onscreen, how information is presented, and how easy is to move around the title. A design prototype should specify the fonts and colors to use and how the navigation system works and looks. This last point is very important in a hypermedial document. Since our audience has no knowledge of the contents, the navigation is entirely guided. Starting from an index, you can navigate to each of the courses, and within the course the navigation is mainly linear. Besides, there are two type of hotwords: the first type show an emergent window when you click on them; while the second type of hotwords navigate to another page. In this page, you just can go back to the first one. In this way, we are ensuring the pupil will not skip out some of the contents or get lost.
3. Developing the content. All the screens have to be outlined, with the text, graphics, videos, sounds or animations they display. Standards for the media have to be established, like the quality of sounds and graphics.
4. Authoring the title. During the authoring phase, contents and media are integrated into its final form. This step comprises using an authoring system; in this case, Toolbook Instructor II.
5. Testing the title. This step involves:
    A. Proof-reading the content onscreen
    B. Checking the title's technical performance
    C. Verifying the title works on different hardware configurations
    D. Evaluating the title with potential students. For this purpose, we organized different pilot experiences with the teachers of the Pedagogy Faculty of the University of Salamanca. They were suitable pupils, as they had no previous knowledge of the contents. These experiences made us return to step 3 or even to step 2: we had to change some animations, some texts (without using acronyms, for example)...
6. Preparing the title for its deliver on CD-ROM. This step consists on packaging the application to run off of CD-ROM, building a master copy and handing it off to a facility. The directory structure must be defined for the master, where all the files are organized together, so the title can locate and retrieve the files as it needs them. Our master includes an autorun file, so the application installs, or runs automatically, as you insert the CD-ROM.
7. Evaluating the title. This is the step we are now located. Virtual Class and the courses have already been used in the course "Telecommunications for Raising Competitiveness in Small and Medium Sized Enterprises", financed by the *Economic Development Agency of Castilla y León (ADE)* and the *European Social Fund (ESF)* and given in CEDETEL. But before drawing conclusions, we are waiting for other two experiences where the CD-ROM is going to be used:
    A. In a course about "Using ICTs in the Learning Process", addressed to future teachers at Pedagogy Faculty in the University of Salamanca.
    B. In a course for physical disabled people within an ISPO (Information Society and Project Office) European Community initiative. This proposal aims at supporting and promoting widespread integration of people with disabilities into the Information Society, informing them about already existing telematics services and Information Technologies. More information can be found at the Web Site http://www.ispo.cec.be/ispo/call/proj97.html#C97110.

Besides the methodology for developing interactive multimedia titles we have here explained, our labor has also resulted in the generation of a document with some advises for developing this kind of titles. Although none of them are new, we wanted to compile them as a result of our experience. Some of them are [4]:

- Multimedia, that is, integrating two or more media effects (text, graphics, sound, video, and animation) can be a powerful communications tool and can accelerate and reinforce learning. Nevertheless, we should not exceed media effects, because they may distract the student and lead him away from what is still the most important: the message.
- The basic unit is not the page, but the screen. For example, we have to take into account that eyes get tired more quickly reading onscreen, so we will not fill it with too much text: at the most, a third part of it.
- We should choose readable fonts, using only one or two: mixing too many fonts clutters the design. The font size and style should be used to convey hierarchy. Unreadable colors and type styles should be avoided.

5. Conclusions

With the advent of the Information Society, all countries, and especially those lacking a competitive industry, are making effort in the human resource development, that is, they are investing in training their population. At this point, SMEs have especial significance in a decentralizing economy.

But the Information Society is not only important as a content, but as a mean too: we should and we must make use of the ICTs to provide access to the whole society. In an educational context, ICTs give us the opportunity of distance learning, that offers many advantages, mainly based on the facts that it is independent from space and time. For SMEs, a very important advantage is that distance learning may result cheaper than traditional learning.

The labor of the work group Canalejas in trying to introduce ICTs into the learning process has got a result in the publishing of the CD-ROM "Basic Course on Telecommunications for Small and Medium Sized Enterprises". During our work, we have outlined a methodology and compiled some advises for developing multimedia titles. We are now applying them to the developing of a mathematics course in CD-ROM for 7 years old aged children and another one about electronic commerce.

Finally, with the impressions from the pupils of the course "Telecommunications for Raising Competitiveness in Small and Medium Sized Enterprises" and the results of the two courses we are giving to future teachers and physical disabled people, we will come to definite conclusions about distance learning and developing CD-ROMs and multimedia titles.

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WebClassroom:
A Java-based Resource for Learning Information Technology

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Overview

An integrated Web-based environment has been developed for learning information technology at Florida Gulf Coast University's Department of Computer Information Systems. This paper presents the distributed learning strategies as well as the tools used. The *WebClassroom* at consists of Java-enabled integrated tools, including frames, hypertext markup language (HTML) and Common Gateway Interface (CGI) programs. Using a Java-enabled browser, students and faculty communicate and view multimedia (slides, sounds, video, animation), electronic bulletin board, electronic chat room, and video images to anyone, anytime and at anyplace. The paper also describes the next version being developed: *The Classroom of the Future*.

Introduction

The Department of Computer Information Systems (CIS) at Florida Gulf Coast University offers the Bachelor of Science in Computer Information Systems; MBA with concentrations in Computer Information Systems and Project Management; and Bachelors of Science in eight Engineering areas in partnership with University of Central Florida via distance technologies.

Students in the CIS program learn to leverage information technology (IT) for business purposes: Creating, developing and overseeing the computer and communication systems and networks used in managing products, processes and services. The result is information that improves organizational and customer services, increases customer loyalty, expands business opportunities, create new products and services, and make the whole enterprise smarter and more efficient. For instance, CIS managers may help unite co-workers in satellite offices; use the Internet (or intranets) to gain competitive advantage (through the value chain); improve the quality and effectiveness of business processes; assist the accounting, human resources, engineering, marketing and sales departments; and help to communicate with the internal and external customers of business and industrial processes. CIS graduates typically begin their careers in areas such as applications programming, systems analysis, database management, network administration, multi-media systems, information management consulting, and project management.

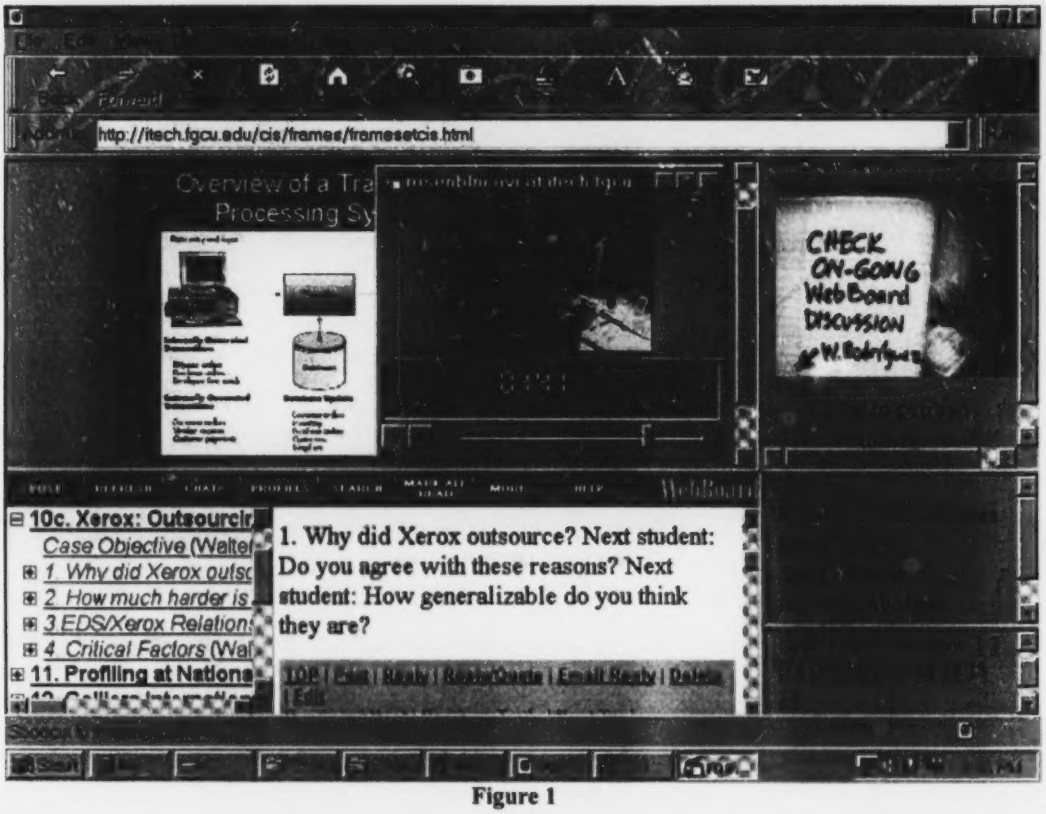
The CIS program uses new Web-based tools within a Product-Process Development Framework: Providing learners with managerial savvy (accounting, decision-science, economics, finance, human-resources, and marketing) and the creative/analytical skills needed to develop, re-engineer, produce, and manage new business products, systems and processes. CIS core courses incorporates a product-process development project. Graduates are able to create, install, operate, maintain, produce and market information---based processes and products. They are also able to develop and manage innovative systems and processes to satisfy customers needs and wants.

At the undergraduate level, the faculty seeks to educate a new generation of CIS professionals namely, systems analysts, computer programmers, network administrators, multimedia systems, project managers, information systems managers, who will have both the business savvy and technical skills to solve organizational and management problems and provide technical solutions for society and industry. At the graduate level, the objective is to educate leaders and entrepreneurs in those areas.

WebClassroom

The WebClassroom is an integrated course-design effort to develop a Web-based "shell" to facilitate the delivery of Computer Information Systems courses central to the B.S. in CIS and Masters in Business Administration. Emphasis is on enhancing interactive and asynchronous group participation.

The WebClassroom's system shell (see Figure 1) contains a series of modules to support CIS courses, such as ISM 3010/6021 Principles of Computer Information. The course modules are used to support key BS in Computer Information Systems program; and allow FGCU to increase its market share in the delivery of Information Technology programs and certifications (CIT).]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2 How much harder is
3 EDS/Xerox Relations
4 Critical Factors (Wal
11. Profiling at Nationa
1. Why did Xerox outsource? Next student: Do you agree with these reasons? Next student: How generalizable do you think they are?

Figure 1

The developmental strategy is simple. Within the developed shell, each participating faculty member designs their course content and determine the set of existing tools that would fit the learning objectives and assessment strategies for the particular course.

The generic "shell" (Figure 1) is being improved with other Web-based technologies, such as low-bit-rate-video-streaming. When completed, the WebClassroom will be called the *Classroom of the Future*. It will bring asynchronous stored in Windows NT servers. In addition, some courses will use high-function SGI O2 servers available in Room II-256 (Systems Development lab) to encode and store course videos All commercial and customized instructional materials will be available to students via the Internet. Students and faculty will communicate with each other from properly configured computers (Java-based browser, NetShow, NetMeeting clients; and other free collaborative software). The *Classroom of the Future* builds upon the author's work with the *WebClassroom* (see Figure 1) for ISM 3010/6021 Information Systems course, as well as recent communications developments.

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http://itech.fgcu.edu/cis/ism3010.htm

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How Internet Experts Search For Information On The Web

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Abstract: This study investigates the information-seeking behavior of experienced Internet users - Internet experts - with a special emphasis on their use of WWW search engines. As Web expertise entails both declarative knowledge and procedural skills, a two-phase approach is taken: Conceptual structures are captured in semi-structued interviews that include a specialised card-sorting technique. Realistic computer-based information search tasks with concurrent "thinking aloud" are then used to elicit procedural skills and interaction sequences in detail. A "process model of human interaction with Internet search services" is derived, which will be presented together with implications for further experimental research.

1. Introduction

The exponential growth of the World Wide Web has turned the Internet into an immense information space with diverse and often poorly organized content. Online users are confronted with rapidly increasing amounts of information as epitomized by the buzzword "information overload." While skills necessary for browsing individual websites seem to be available to users after only minimal training [Hurtienne & Wandtke 1997], considerably more experience is required for query-based searching [Pollock & Hockley 1997] and inter-site navigation.

The underlying question of the research presented in this paper is, how do experienced Internet users -- I shall call them "Internet experts" -- manage to use the Internet effectively for their information needs and, more specifically, what knowledge structures and strategies do they use?

What defines an Internet expert? For this research I choose to define "Internet expertise" as the knowledge and skills necessary to utilize the WWW and other Internet resources successfully in solving information problems. A better understanding of such Internet expertise could provide a benchmark both for education, i.e., Internet skills training, and human/computer interaction, to ease the difficulties faced by beginning users.

Search engines such as Altavista or Hotbot are a central part of information seeking on the Net, requiring sophisticated knowledge for their efficient use. They were chosen as a focus for our investigation because they have a prominent position among Internet resources. Search engines are more similar to query-based data-retrieval systems than to browsable hypertext systems allowing to build upon models from both Library & Information Science (LIS) and Information Retrieval (IR) research [see Marchionini, 1995].

2. Empirical Investigations

Web expertise can be most broadly divided into 1) declarative knowledge about the Web / Web resources and, 2) procedural skills such as interaction sequences and strategies or tactics. To tackle these two aspects of Web expertise I adopted a two-phase approach to data collection. In a semi-structured interview that includes a specialized card-sorting technique, the focus is on conceptual/propositional knowledge structures. Computer-based search tasks with concurrent "thinking-out loud" are then used to elicit procedural knowledge and interaction sequences in more detail.

2.1 Phase I: Interviews

Phase I aims at identifying those concepts and concept structures that are relevant for successful information seeking online. The experts are asked to describe their familiarity with the available search services, their search behavior and their intentions/rationales for using certain sources and strategies. The interview includes mental

walk-throughs of search tasks and open-ended questions about search strategies such as shortcuts or problems encountered with online information. Interviewees' responses are assigned to categories and recorded on color-coded cards that contain predefined categories including goals, action sequences, and others. This is followed by a card-sorting task [see Janetzko 1998] in which respondents are asked to use a given set of relations to express their mental model of what they know about the Web, by building a structure of the concept cards and their interrelationships. This type of card sorting is employed to make the concepts and especially concept structures more explicit than would usually be the case in an interview. Further analysis is performed on the session protocols to pinpoint additional concepts that might have been missed in the card writing task. This type of broadly based, qualitative, and exploratory investigation can generate fruitful hypotheses for upcoming experiments.

2.2 Phase II: Web-based Information-seeking

The second phase of this expert study consists of real-life information-seeking tasks that have to be performed by the experts on a PC connected to the Internet. All inputs to the PC are made by an assistant of the experimenter. Participants are required to give detailed instructions to the assistant, who performs the commands as given. This approach forces them to make every step of the interaction process verbally explicit, including those that might otherwise be glanced over because of the rapid action sequences. During the session participants are also requested to think out loud about their search activities and give reasons for their online behavior.

Process models of information seeking in electronic systems have been proposed by [Shneiderman et al. 1997] and [Marchionini et al. 1993] and others. Building upon such models, I seek to explicate a "process model of human interaction with Internet search services." This process model is derived from the interaction sequences that are recorded in the second, computer-based phase of our investigation.

The quantitative data from the computer-based tasks on search engine utilization by the expert group will also be analyzed, including the number of search terms per query, number of refinement steps, use of special features such as Boolean operators, truncation, phrase markers or field search etc. These can then be compared with a large data set derived from a general population of search engine users supplied by a major German search service. Such a comparison allows for an initial investigation of the differences between expert and non-expert users in the domain of search engines.

The research presented is clearly a work-in-progress, part of a larger project that investigates the cognitive resources involved in searches on the WWW. This project consists of both exploratory studies and experimental research in a laboratory setting. Such experiments will hopefully shed light on individual steps of the search process such as query term generation and selection, for which the paradigm of word association experiments is employed. Here, expertise is further differentiated into the technical "Internet expertise" discussed above and domain-specific content expertise to get a more adequate picture of the knowledge structures determining search behavior. Follow up research based on the findings of the present study will be discussed at the end of the talk.

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Dynamic Generation of Web-Based Adaptive Learning Environments: A Design Case for Teaching the Writing Process

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Abstract: A web-based writing tutor has been designed as a follow-on to a successful 7-year U.S. Air Force research program into the evaluation of adaptive training technologies. The new writing tutor design is highly adaptive to student learning styles and goals, and generates customized instruction dynamically based on the use of interoperable 'learning objects' distributed across the Internet.

Background

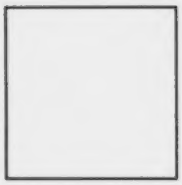
MAESTRO is a LAN-based adaptive tutoring system that provides coached practice in the *writing process*. MAESTRO is part of a multi-year U.S. Air Force research program into the effectiveness of representing cognitive writing tasks visually in an adaptive tutoring system environment. MAESTRO has been implemented with 8th-10th grade high school students in 5 U.S. states [Rowley, Miller, and Carlson 1997; Rowley and Crevoisier 1997]. Information on the complete writing research program, including research reports, is available on the web (see http://www.brooks.af.mil/AFRL/HEJ/fst/maestro.htm).

Due to the success of MAESTRO and interest in Internet-based adaptive tutoring systems, a follow-on writing tutor was designed as a web-based system. The web writing tutor (WWT) will make use of interoperable 'learning objects' that are combined on demand to dynamically generate custom training that is pedagogically relevant and adapted to student learning styles and goals. WWT will provide a proof-of-concept test for the idea that interoperable learning objects that are distributed over the web can be combined dynamically in real time to generate an environment that is adaptive to student needs [Rowley 1995; Rowley, 1997] (for further information on this strategy, see: http://www.contrib.andrew.cmu.edu/~plb/AIED97_workshop/Rowley/Rowley.html). The curriculum for WWT includes a simplified writing-process representation appropriate for low grade-level readers, as well as intermediate and advanced level treatments. Additional curriculum are being developed for adult learners.

Dynamic Generation of a Web-Based Writing Tutor

The WWT's technical architecture is designed to provide an interoperable intelligent tutoring system environment [Anderson, Corbett, Fincham, Hoffman, and Pelletier 1992]. This includes an overarching control architecture in which interoperable learning objects are selected, combined as needed and run. The learning objects utilize a knowledge base and inputs from a dynamic student profile to adjust their treatments of the subject.

The objective of the WWT's design is to allow multiple web-based instructional mini-applications to be combined as needed and managed by a controlling application. This is accomplished through five types of software modules, or objects, including curriculum control modules, a data-flow



controller, a domain ontology, a student profile, and learning objects (LO), which are the primary instructional applications (see Figure 1). The curriculum controller presents the initial interface to the learner, then uses the data-flow controller to locate and select appropriate learning objects based on the student profile. The curriculum controller uses a domain ontology (a knowledge base) to help determine what to teach, and the student profile information to help it decide how to adapt the LOs and present them to the student. The LOs each adhere to technical communication standards as well as learner interface standards. The LOs each teach parts of the overall skill being tutored. Each LO is adaptive to some degree, based on inputs received from the curriculum controller. The LOs are not restricted to any particular type of programming language, as long as they run in a web browser, and adhere to the tutoring environment communication standards. LOs may include HTML scripts, JAVA-scripts, JAVA applets, XML scripts, IMS meta-data, VRML worlds, KQML/KIF accessible knowledge bases, and related software.

Figure 1: Architecture of a Dynamically Generated Web-based Adaptive Learning Environment

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WWT is designed to be highly diagnostic, utilizing survey and self- or teacher-assessment information to focus tutoring activities on areas of the writing process where the individual student is in need of assistance. This is accomplished through the use of a standardized problem-solving grammar. The grammar is problem-solving in the sense that communication includes goal-based statements with identifiable objectives and completion criteria (see http://www.brooks.af.mil/AFRL/HEJ/fst/vocab4.htm). Based on the identified objectives and the current learner profile, WWT will transmit only those portions of the tutoring system needed by a student at a particular time. The WWT environment will support the utilization of leading-edge web technologies including streaming video, multi-platform compatibility, and the use of VRML simulation environments.

The WWT design is supportive of standards currently being explored by several large-scale cooperative efforts to define generic learning environment software objects including Educom's IMS project for meta-data standards (http://www.imsproject.org/), and the IEEE Learning Technology Standards Committee on interoperability standards for learning technologies

(http://www.manta.ieee.org/p1484/). WWT will demonstrate the feasibility of an open interoperable architecture for the dynamic generation of adaptive learning environments.

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Hiring and Retaining Technology Support Staff in Academia: The Student Workers

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One of the greatest challenges facing academic computing today is the effective hiring, training and retention of information technology staff. This challenge has become more difficult as institutions have developed proprietary electronic learning environments. The keys to providing successful student based support for these systems require managers to understand the user environment (the differences between distant on-line support and local), student worker motivations and the nurturing role of student managers in academia. Experience has shown that non-traditional students (those without computer science or MIS course backgrounds) are often the most successful user support workers. Key features in our successful hires have been language skills, problem solving skills and interest rather than a litany of software or hardware experiences. Effective communication skills have been the most important for student workers providing distance support of users.

Information Infrastructure of University Education

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Abstract: The concept of education with the Information Communication Technology (ICT) support for the university teaching level is presented. The high performance network of Physics Department at MSU is described. The information block develo p-ment concept will be reported. The software standards for teaching materials are discussed. The ICT support of lecture courses experience and the projects of open distributed learning (ODL) for MSU departments and elementary schools are d escribed.

Introduction.

The basis of university activity is a process of teaching, which is formed from methods and tools of education in art and science. At present time in tools and methods of education sufficiently rapidly enter the modern information technologies, changing our glances and beliefs about the most process of teaching significantly increasing its possibility and quality. Educ a-tion processes to become more dynamic and information capacious and increasing the data transfer speed do it also distributed. Thereby, education becomes more available and uniform ensuring access the universities and knowledge, accumulated in its, to the wilder academic auditorium, which practically becomes the whole world.

Consequent growing of data transfer speed has brought about shaping the three speed feature levels: - 64 kb/s, 2-10 Mb/s, 100 Mb/s and above, to which are created and developed their own intellectual tools and network facilities. They a c-cordingly form the media: of intellectual contacts, research and education. All these media interconnected are mutually enriched and bring about the consequent growing of the society potential and each of they are kept a process of learning.

Intellectual tools of each data transfer speed level are formed in accordance with possibilities of network facilities, i.e. issues of certain volume of information and supporting its software. The first level corresponds the process of formation e x-change are used small amounts of traffic data, second level corresponds the research area when the amount of experimental and theoretical materials are significant. The third level is education and it works in multimedia mode transmitting and receiving a big volume of information.

Network facilities are a modem network, Ethernet, FastEth ernet, Gigabit Ethernet and ATM with corresponding transport media: - telephone lines, coaxial cable, UTP and fiber optics links. And as a temporary, reserve communication facil i-ties can be used microwave and satellite links.

Accordingly under each level are created and perfected software tools. Software, either as communication and network equipment passes a way of development standards and their approbation. Improvement and software development must go on way of maximum compression of data transfer given for the reason raising a quality and volume of information under minimum speed data transfer. This comprises of itself process of organizations of dataflows, textual search system development, and in - formation packages compression and on physical and technological levels - an asynchronous issue, traffic checking and virtual network management. On this way can be provided reduction of data transfer speed and provided its maximum quality.

In our paper we will discuss a third level - education and will consid er its intellectual tools and network facilities which are required for creation the education network of Moscow State University (MSU).

Education with ICT support of any level at modern stage logically is possible to support all "standard procedure" of learning process: lectures with audio- video conferences support, students classes with the system of interactive test, laboratory classes with the online experimental facilities, electronics library with the context search systems, advisory board network service and so on. So there are some opinion that it is the possibility of complete imitation of the elementary and higher educ a-tion system.

In addition the relatively simplicity of the standard Web applications by the direct converting the text and multim edia files brings to force contamination of the information space and give the difficulties for the choice of really need elements from the suggested "swollen" network database. Therefore exist the real dangerous of the beginning of the cold information "cultural layer" on the way of the development of educational networking resources and as the result - "overflow" and the higher "noise level" in information background of networking support education system.

In our paper will be presented the conception of the universities education network, on the authors opinion permit to overcome the mention above the " baby diseases " of the development the open distributed education in Russia. As the illustr a-tion of the concept realization was chosen the Physics department at MSU, having more then five year experience in operation of network resources in education, research and management. It is as the proving ground of the development and testing of log i-cal, hardware and software networking solutions for Moscow State University. The Physics department is the biggest depar t-ment at MSU. It has 2500 students and 1500 staff members.

The development level and using the information technologies in science and education is defined by the main poss i-bilities of university, country and the world to organize of high-speed performance external communication channels. The func - tion of modern condition of data transfer speed mode of world telecommunication possibilities is shown on Fig. 1. Seen that speed performance mode of the world Internet users has a maximum in the region 100 kb/s while for full realization of educa -

tion possibilities it must be well above. Full-fledged and active using the information technologies in education and research activity requires the following speed modes: in education before 1-10 Gb/s, for research - 10-100 Mb/s.

ICT education network initially requires high-speed performance network as far as exchange by information occurs in multimedia mode. From brought speed mode of world users follows that active using Internet for education only started and its undertaking requires presence to high speed performance network of university (100 Mb/s) and high-speed performance exte r-nal channels (10 Mb/s and above).

Fig. 1. The perspective of the Physics Department ICN.

Evolution of data transfer speed modes of telecomm u-nication system of Physics department at MSU with 1992 on 1998 and distinctive speed area to their realization in different subnets on the medium 1998 is shown on Fig. 1. (By the symbol of the department and university). The modern status of Infor-mation Communication Network (ICN) of Physics department at MSU shows that the department is ready for active using the information technologies in education and research. The most further development of the department ICN will go on way of improvement only and increasing its powers and full-fledged exhibit development for scientific and education whole.

The Russia national academic networks have the fol-lowing external channels possibilities: MSUnet - an overland channel - .5 Mb/s, FREEnet - an overland channel - 2 Mb/s, RUHEP/Radio-MSU - 1 Mb/s satellite link and 128 kb/s ove r-land channels and RUNnet (Russian University Network) - 4 Mb/s satellite link and 6 Mb/s overland channels. Thereby for active using the information technologies in the education pro c-ess it is necessary to increase Russia academic network channel possibili ties.

However, the channel possibilities of Russia Universities allow already presently to begin a shaping the national net - work resources of education. High speed performance network with 1-10 Gb/s will require new approaches to shaping a topol - ogy and network architectures, but does not require education software products modernization, which were designed and used at a speed level given 100 Mb/s.

MSU United Telecommunication Information System.

In 1997 in the MSU was created United Telecommunication Information System (UTIS), which has united all co m-munication and information facilities of the Moscow University. At present practically created the global university network infrastructure and were established the fiber optics transport media between MSU buildings located on Lenin's Hills and in the center of Moscow [1]. Thereby were created the united high-speed performance MSU transport media on ATM (155 Mb/s).

Fig. 2. RUNnet nodes operated by Physics department center.

Relationship with scientific-education Moscow's centers and Moscow region is realized by means of micr o-wave facilities, located on high-altitude (200 meters) of Main MSU building and by the overland fiber optics links. In the MSU also are in operation Federal nodes of Moscow regional network RUNnet, which begin its functioning in the September 1994. Satellite antenna and operation node is located on Physics department and the control room is at MSU.

The Physics Department RUNnet center support the operation of high speed performance channel with r e-gional academic-research centers (Fig. 2.) as Novosibirsk State University (128 kb/s), Ural State University (128 kb/s), Ul'anovsk State University (96 kb/s), Nizjny Novgorod State University (64 kb/s), Perm' State Technical University (256 kb/s). The satellite ground station is located on the Physics Department building. The information channel loading near 672 kb/s so will be possible to connect to the node another regions of Russia. The operation comes through the communication satellite "Raduga". The connection to the satellite supported by receiving-transmitting station for satellite communication "Kedr -M". The transmitter power up to 40 W and it permits to support the information channel up to 4 Mb/s. The data processing based on 5 satellite modems SDM of EF-DATA Company. The operation is on Cisco 4000 router.

Moscow University has direct access to Global Internet which at present established on channels to US (0.5 Mb/s), to Nordunet (through RUNnet), to Hamburg (1 Mb/s, through Radio - MSU). In combinations with rebuild overland RBnet cha n-nels, new Internet centers (on the program of Institute "Open society" and Ministry of Science of RF) these facility present itself perspective communication base for the beginning of shaping to educational network of n ational scale.

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Telecommunication system of MSU Physics Department.

The ICN of Physics Department on transport parameters is divided on LAN of the department, modern pool and external communication links [2]. LAN of the department based on Ethernet, Fast Ethernet and ATM topology with the thin coaxial cable, UTP and SM fiber optics as the transport media and consists from the several segments connected to Information Systems and Technology Center (ISTC). The ICN of Physics Department consists of three subnets: education, scientific and administration, working at low speed level (10 Mb/s) and high speed level (100 Mb/s) segments (Fig. 3.). Internal department network has before 600 computers in local network and more than 600 computers on modem connection.

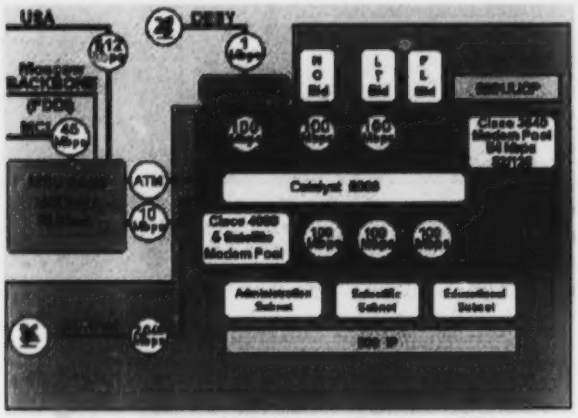

Fig. 3. Layout of MSU Physics Department ICN.

The sequential moving the ICN inside the department based on the subnode organization (at present time - 6) with the network routers and repeaters with the further ramification to network segments. The network protocol is TCP/IP it permit the naturally integrate the department network infrastructure directly to Internet.

The ICN scheme (Fig. 3.) includes two fiber optics link to MSU node, fiber optics links to remote Physics Department buildings as Nonlinear Optics Bld., Low Temperature Bld., Magnetism Lab. Bld and NPI MSU and internal network of the department LAN formed as three big subnets: scientific, education and administration.

If address to evolution of structure of network resources of ICN (Fig. 4.), conditionally possible select four greater stages. The first four years with 1992 on 1996 have left on making a network infrastructure and shaping its control center with ensuring a necessary service for network users. A making of a scientific department subnet on Ethernet topologies and its use for raising a scientific potential of the department.

In parallel with the development of network infrastructure increasing an entering the scientific employees and teachers in new for them world of information technologies. Practically for given periods were created necessary conditions of transition on high-speed performance links, but real they're mastering has begun in 1997. It was perfected technological and software aspects of using of communication, network and computer equipment for FastEthernet, conducted its testing and the development of optimum states of working. In this time occurred a consequent increasing a using the information technologies in education. Given period is characterized more deepened by using the information technologies in scientific functioning the employees and students.

Fig. 4. Evolution of the Physics department ICN.

From February 1997 department ICN translated on transport media with the data transfer speed before 100 Mb/s and from summer 1997 on ATM (155 Mb/s). Parallel were laid fiber optics links to central department auditoriums. For the reliable operation to education network were also laid links on UTP, but used earlier coaxial cable lines were left as reserve. Commissioning of fiber optics links in central department auditoriums has allowed testing communication, network and computer equipment on 100 Mb/s from the level and realizing a maximum data transfer speed before 50 Mb/s.

Information blocks for ODL and standards of its presentation.

On the base on education ICT network of Physics department was started the checking of transport media structure, logic control, hardware and software testing for education ICT network university. It was begun wide scale introducing the information technologies in the teaching process and their active use in lecture courses and development standards teaching audio and video education materials.

The process of creation and development of the ODL system on the Universities of Russia level provide the simultaneously solution of fourth heterogeneous tasks:

- forming the transport media of Inter-network communications which give the possibility to realized already existed at present time all spectrum of network services in education;
- creation the conception of the network development from the position of selection the educational material and the form of its presentation;

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- establishing the standards of the presentation the network products on the software level support as "multipla t-form" of working applications as the possibility of development of autonomy information analogues for the appli-cation in LANs;
- standards choice on the architecture, hardware and software support of Intra-network of the universities and a n-other academic institutions.

The priority task of information support of the education process, accordingly the taken conception, is to summit the access to intellectual resources of the university teaching - educational network on the moment of the demand forming on ed u-cational service. Therefore under the choice of the technological solution for the architecture and hardware base of the comm u-nication system the main will be the realization practically direct regime access to "network teaching auditorium". On the tec h-nological level it correspond the high-speed performance of data transfer and data processing the creation the systems of loading the database array of the high volume.

The contents of the information resources of the open distance university education system first of all must to reflect the real educational, or more narrow - learning process [3-5]. The unity of the research and education activity which are inherent in university education, big volume of authorized original developments, mobility of the learning courses programs require in principle a different approach under the choice of the standards of the information processing such materials to compare with the fully developed standards of multimedia type as "electronics education books". Can be determine five main directions in information support of the education process oriented on different groups of the "listener":

- forming the information "mirror" of auditorium work of teacher;
- development accompanying information materials to support the teacher work;
- creation the On-line education "training machine" (local or global experimental facilities, model system);
- development the online and outline assistance system and knowledge testing;
- development and accompanying the unified database of the education materials.

The sequence of enumeration of the information resources correspond its priority for the developers and opposite pr i-ority for the users of the information accompanying of education system or system of open distributed education.

Weekly volume auditorium lecture hours, to which works in the mode online information support system forms 32 hours for cycles of physical profile and 38 hours with the account of mathematical and humanitarian cycles. Technological mode occupies not less than 400 hours for workstations and round-the-clock operation for servers group.

After the two years testing of information presentation for the education network of MSU were selected the next sta n-dards:

- *RealMedia - for the direct access presentation to lecture fund on humanitarian discipline,*
- *RealMedia and MPEG3 - for audio accompanying system for foreign language teaching (English, German, France for Russian students and Russian for foreign students),*
- *MPEG1 - for video accompanying of different education courses,*
- *JAVA - terminals to realized the online regime for work with remote access experimental systems,*
- *PERL - management for the interactive testing system and assistance,*
- *ORACLE - Database as an integrated base of education development of MSU and another academic institution of Russia.*

The standard selection for information blocks presentation were based on the criteria of compatibility with the diffe r-ent types of hardware and software configurations of the workstations of clients in different Russia regions, typical speed r e-gimes of information exchange, the possibilities of creation of autonomous mirrors copies or CD - analogue of information blocks, the information security level and the prediction in the software development.

A high-speed performance segment department ICN establishing stimulated a spreading accumulated in the process of its usage's of experience on the connection of computer classes of department, which at given time were already modernized on multimedia computers presented by the "Intel" company. Were laid speediest communication links before language cabinets and library and in the near future they will be also enclosed in the education subnet. The computer classes used for educating the students to programming and numerical methods can be used as reference classes and classes of preparing the students to occ u-pations. Language cabinets equipped computers and speediest access, - an active studying English language by Russian students and Russian language - by foreigners.

ODL for Moscow State University and Moscow elementary schools.

In 1998/99 academic year is offered to conduct a joint experiment of Physics, Geology, Chemistry Depa rtments and Department of Basic Medicine (Fig. 5.), supported by MSU transport media. The software development, computer, communi-cation and network equipment will be tested for whole remote teaching on courses "General Physics", "Ecology" and "Foreign Language" [4].

On the first stage will be established single mode fiber optics links to auditoriums specified department, adjusted and installed communication and auditorium equipment (workstation and multimedia projector), formed servers part of education segments of departments network and tested technological and transport media.

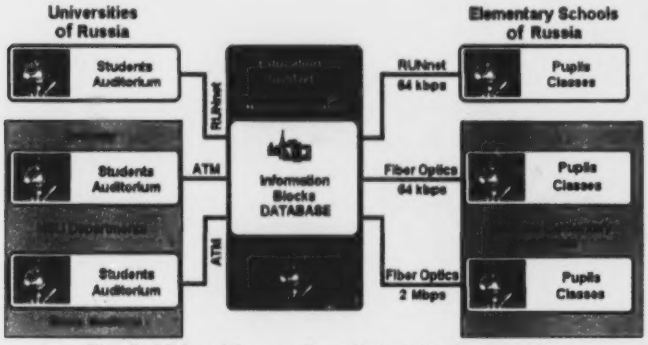

Fig. 5. ODL at Moscow State University departments.

Practical functioning is expected to begin from remote educating with teaching interactive materials opened by bases of on courses general physics. Professors of Physics department, delivering the lecture in general physics courses to students of specified departments will use illustrative materials from databases of education server of Physics department and Internet. Will be tested inter department network cannel's possibilities, tested their speed modes and worded requirements for MSU education network.

On each department will be formed the groups of professors, which proceed with the information blocks development on under study subjects (geology, chemistry, medicine) and delivering the lectures with the ICT support. Also will be designed the standards and requirements of granting in MSU education ICT network materials for making the databases on their specialties. In parallel will be tested database Oracle-8 and determined standards on client and server part. Will thereby begin a shaping an education information space of Moscow University, which hereinafter can use MSU departments and Russia univers ities.

Presented desirable to conduct an experiment on remote educating from MSU to one of the Russia University. This will allow to perfect mechanisms of access from education network of MSU to universities of Russia, including the RUNnet facilities and thereby begin a shaping of information educational space of Russia, i.e. national information network resources of education.

Consequent development and a filling education ICT network at the MSU departments will allow to create the archive of teaching materials with high speed access facilities. At present in different countries have proceeded with the development of such powerful devices of keeping and distribution information. Such - Warehouse - can be designed and created in the new building of library on the new MSU territory. Hereto time will already be perfected and designed corresponding shaping facility, keeping, searching and sharing a big volume of information with the high speed access with MSU departments and Russia un iversities.

Physics department this year plans an undertaking an experiment in Moscow elementary schools with the software development, computer, communication and network equipment testing for whole remote education on courses "General Phys ics", "Astronomy" and "Ecology".

Undertaking such experiment requires presence several components to its successful realization. First, it is necessary to choose schools of city having potential technical possibilities for a given experiment. Secondly, in chosen schools must be a teaching staff adequately accompany on the experiment and having for this corresponding qualification.

For the experiment were chosen two school close work with MSU Physics department, where occupations on the physicist from Physics department and Moscow City Palace of Creation of Children and Youth on Lenin's Hills (MCPCCY), with which have the good relationships with the Physics department. As a transport media will be used SM fiber optics links with speed transfer from 64 kb/s to 100 Mb/s.

Fig. 6. ODL at Moscow elementary schools.

The project will consist from two parts (Fig. 6.). The first will be the development and creation technological and transport media with remote educating with teaching interactive material opened by bases of on courses general physicists with physics department in schools 1134 and 1189. The second one will be shaping under MCPCCY the communication node for service and accompanying as a segment of Moscow elementary school's network.

On the first stage are perfected technical and technological questions, is installed servers and communication equipment and is educated operating personnel, is formed teaching staff for the occupations with schoolboys on different professions and begins development of methodical and teaching materials for educating the schoolboys.

In MCPCCY before the October-November 1998 will be created server cluster for servicing and accompanying to information network of elementary schools with consequent

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connecting of first two schools, but then, on the measure of increasing of communication and network equipment and other schools of Moscow. Parallel in MCPCCY will be also conducted learning the schoolboys on "General physics" and "Astronomy" with development methodical and teaching materials.

In 1996/97 academic year near 10 schools Moscow were connected on UUCP to ICN of Physics department, but they are basically introduced with functioning an e-mail and in different information networks and databases. Shaping in education subnet department materials, calculated on the different speed performance mode of data base communications, without their quality loss, will allow to perfect mechanisms of transfer a teaching material on modem network of department that will serve a central to granting the educational materials on home computers of schoolboys and all wanting. Creation in the composition of education subnet of the department - DIAL UP IP will allow to begin a remote education on low speed performance (before 64 kb/s).

Conclusion

The undertaking described above experiments will allow proceeding with shaping university and school educational networks in Moscow with further access on Russia telecommunication possibilities. Will thereby be fixed a relationship before higher education and higher education levels for the reason raising a quality of education on the base of modern information technologies and making an uniform education to different teaching discipline in Russia.

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WebBeholder: A Revolution in Tracking and Viewing Changes on The Web by Agent Community

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Abstract: The WebBeholder is a cooperative agent community framework that provides open services on finding and displaying changes on the World Wide Web. Several agents and components in the community interact with one another to achieve the goals issued by users of the system. The system consists of a service provider agent that keeps watching and detecting changes on the Web, a number of personal mobile agents that represent each user, and a number of mediators to negotiate with the service provider agent for incoming personal agents. This paper describes the framework with an emphasis on evolution of the system, the interaction among agents and components, and our algorithm for generating comprehensive presentation of changes in structured context like HTML documents.

1. Introduction

The information in the WWW is supposed to be changed dynamically without any prior notification. Browsing through the sites for new updates is not only time consuming task but also vain in case that there is no change made on the sites once visited. We need some representatives to do such burdensome and tedious jobs for us. Furthermore, we would like to know when the changes occurred and how they look. That means not only tracking tools but notification and presentation issues are also taken into account.

Our research proposes this agent community framework in order to establish a more flexible and efficient approach to accomplish the changes detecting and displaying goals. The system features the flexibility and efficiency of using mobile information agents in constrained environments. The changes detection services in the community is provided in the way that the users can fully customize their agents to meet individual user model rather than posting all their preferences to be served by centralized server.

At the same time, the system focuses on presenting detected changes from the HTML Difference Engine. It implements our algorithm called Longest Common Tag Sequence (LOCTAGS) to determine meaningful changes in structured context like HTML document. This paper is divided into two main parts. The first main part is devoted to explain the evolution of the WebBeholder. The latter main part describes the formation and implementation of LOCTAGS algorithm.

2. Formation of the WebBeholder

A WebBeholder community is the community that consists of a service provider agent, a number of mediators, and a number of mobile agents that represent their users. The users customize their own agents to meet their preferences before dispatching them into the community. These agents are called personal agent. The WebBeholder community is designed to provide an environment in which various kinds of agents can interact with one another to achieve change detection and presentation on the Web.

2.1. Architecture

The environment of overall system for the WebBeholder community is shown in [Fig. 1]. The users of the community dispatch their own agents to the Mediator via the Internet. At the Mediator site, all personal agents are bound in a provided platform which the agents can execute their codes under a restricted control. There are three service modules within the Mediator. All service modules run independently. Each service module serves the personal agent in its own queue. The Request Broker is the module that negotiates with and posts the queries

to the Service Provider Agent for the personal agents.

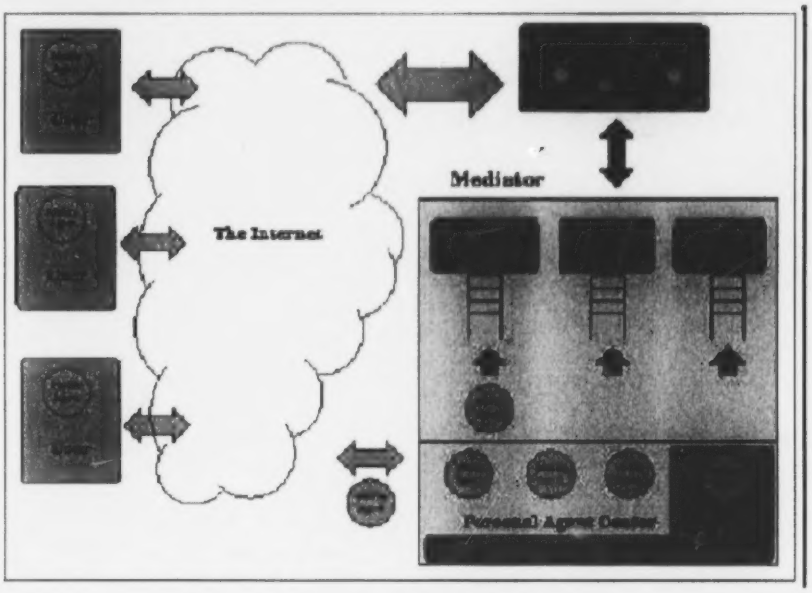

Figure 1: The WebBeholder Community.

The *Navigator* module tells the personal agents about locations of other WebBeholder communities. This service is provided in the case that personal agents could not find any information on the pages assigned by their users. The personal agent can query the Navigator to look further for some communities that have the desired information.

The *Facilities* module provides facilities for incoming personal agents. Since the mobile agents in the provided platform of the Mediator site have restricted access to the Internet and resource usage, the Facilities module offers these facilities under limited operations. The details of facilities are described in the topic Facilities in the Community

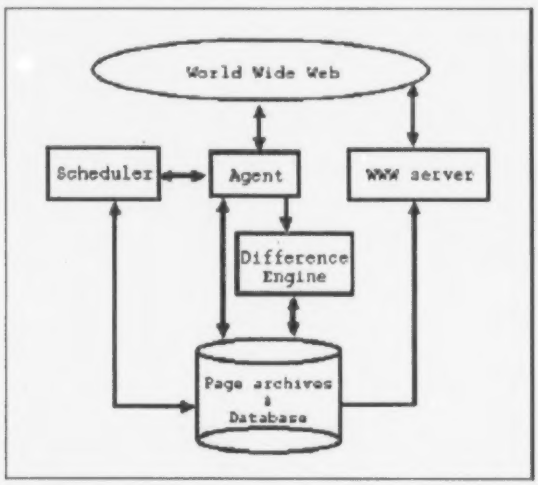

Figure 2: The building blocks of the service provider agent.

The main agent that offers services to the community is the *Service Provider Agent*. The architecture of the service provider agent is shown in [Fig. 2]. Its main modules can be listed as following:

- **Agent**: It is the heart of the service provider agent. It interacts with other modules in order to retrieve and

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compare HTML documents.

- **Scheduler**: The scheduler will look up the pages registered for each user then makes a schedule of checking for the user. It constructs a timetable for the agent to make sure that each user will be served right in time.

- **Difference Engine**: The agent implement the Difference Engine in order to compare the content of updated pages and see whether there are significant changes in them. The old and new versions of HTML documents are compared by running the Difference Engine. The results from Difference Engine are very important for the agent to classify the changes. At the same time, it will summarize the updated information into another HTML document by innovative algorithm proposed in this research. The detail on Difference Engine is given in the Difference Engine section.
- **WWW server**: The page archives contain the old and new version of Web pages together with summary pages constructed by the HTML Difference Engine. When users are notified by their personal agents, they can view the changes with their browsers via the WWW server.

2.2. Facilities in the Community

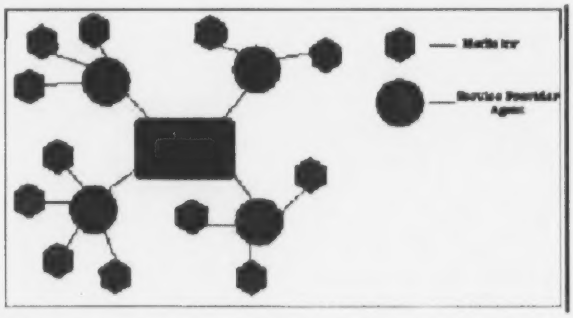

Figure 3: A number of WebBeholder Communities are linked together by a central Community Location Server.

The facilities in the community can be listed like the following:

- **Post Office**: The personal agents may have messages for their owners when they find something interesting or just for emergency cases. The message can be sent via the post office of the community.
- **Accommodation**: This provides accommodation for some personal agents that wait for some predictable events or could not go back to its user for a while.
- **Broadcasting service**: This facility allows broadcasting to all agents in the *Personal Agent Center*. This facility is also used to establish communication among personal agents.

2.3. Communication Among Communities

The WebBeholder communities are linked together as shown in [Fig. 3]. The *Community Location Server* is the center of all communities. Its holds the information about location of service provider agents, the Web pages they are responsible for, and their Mediator sites. The information may be asked from the Navigator modules in Mediator sites in order to dispatch some personal agents to where the desired information is already provided.

3. Difference Engine and Presentation of Updated Information

As the information retrieval module of the service provider agent gathers updated pages from the Web according to the schedule assigned by personal agents, the Difference Engine is activated to scrutinize updated information. The results from this investigation are divided into two categories. The first one is the result from the evaluation of updated information. The agent needs to know whether the updated parts in each page are significant enough to interest the user who posted the query. This result is also used to determine whether the

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changes are worth informing to the user. The second category is the result for presentation. The Difference Engine produces a document page that shows the revision of the updated page so that the user can review and jump from change to change without difficulties.

The following sections describe the formation of the method for checking and displaying changes in arbitrary two revisions of a specific WWW page. We developed an algorithm called *Longest Common Tag Sequence (LOGTAGS)* to match tag sequences in old and new version of HTML documents. The algorithm was applied to help finding the right places for context comparison within a pair of HTML document. The differences are justified in a new HTML document conforms to its updated version's outlook in the way that the user can identify the differences at ease.

3.1. Longest Common Tag Sequence

HTML document consists of markup tags and context. The Difference Engine is designed to parse the HTML document based upon the basic that each tag is followed by context.

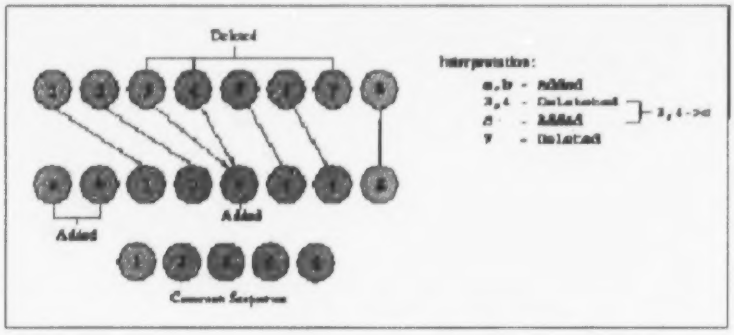

Figure 4: An example of presentation of updated sequence.

The merit of this method is that the HTML parser has no need to understand all the given tags described in HTML specification. In long run, the method is still valid for new markup tags introduced in later version or super set of HTML specification (to some extent, since the method is blind to the meaning of content-defining markup tags). However, the concept simplifies the parsing process remarkably and suits for processing large scale WWW pages comparison.

We applied the same concept of text comparing algorithm that implement the Longest Common Sequence (LCS) of characters in string. We view the HTML document as a string of markup tags and context. The algorithm treats the context and tag sequence separately but keeps the processing order in right sequence. The algorithm can compare the context to its pair at the right positions because the sequence of markup tags are checked and recognized. [Fig. 4] shows an example of interpretation based on the common sequence of both sequences.

3.2. HTML Difference Engine

The HTML Difference Engine was constructed to compare a pair of HTML documents. The output of the Difference Engine can be separated into two categories. The first one is the information of changes found when comparing. The second one is the HTML document that presents the changes. The code base of some links, images and JAVA applets are modified on the fly, so that we have no need to hold all images or applets' byte code locally in order to enable direct browsing when the user view the summary page. The longest common tag sequence algorithm is applied to construct the HTML Difference Engine, which is able to create smart presentation of changes detected in form of HTML document.

The architecture of the HTML Difference Engine is shown in [Fig. 5]. Old and new versions of Web pages are fed to the tag parser module in order to generate the tag sequence for Longest Common Tag Sequence Detector. Differentiator compares all tag streams in order to find additions, deletions, and corrections. The comparison process in the HTML Difference Engine detects the changes up to the level of one character. This

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information will be used to generate the final HTML document that indicates the changes detected in form of merged presentation.

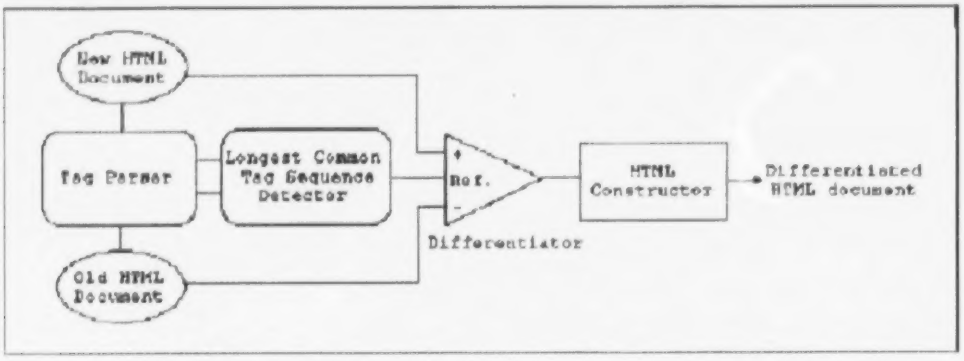

Figure 5: The building blocks of Longest Common Tag Sequence HTML Difference Engine .

3.3. Scoring of Changes

The service provider agent is also responsible for scoring the detected changes. The information is needed to determine significance of changes. The personal agent receives this information via request broker and performs evaluation base upon the preferences of its owner.

We use change scoring model to provide this information. The scores of change categories are listed in the [Tab. 1]. The scores are assigned to the categories according to their roles in HTML specification. The HTML Difference Engine accumulates the change scores associated with their categories. The total changes are considered significant if the score goes higher than a threshold value that is specified by each user.

Table 1: Change scoring for general HTML document

Category	Score
URL in < A href=...>	256
Java Applet's Bytecode	256
Image in < IMG src=...>	128
Page's Title	128
Background Image	64
Background Color	64
Header < H1> ,< H2>	64
Header < H3> and smaller	32
Text (per character)	1

4. Implementation

The agents and components in the WebBeholder are coded in Java. We implement the mobile agent package called *Aglet* that is provided by IBM Tokyo Research Lab. [Aglet 97].

The prototype of the WebBeholder has been tested locally in our laboratory. We have run two WebBeholder communities to serve some users that assign the service provider agents to keep eyes on approximately 200 pages on the Web. The users get notifications when change scores of observed pages become higher than thresholds provided for each page.

[Fig. 6] shows an example of change presentation. The deleted parts are displayed in stroked text. In the case that the deletion involves an URL link, a footprint icon is added to the tail of stroked text in order to indicate the deletion of the URL link. On the summary page, some implicit URLs that link to local pages on that site are modified during comparison process so that the users are able to click and surf the deleted link (if available). The deletion of a link does not imply the existence of that link on the World Wide Web. The addition parts are displayed in underlined bold text. In the same manner, a peg icon will be attached to the tail of any link that is

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inserted to the Web page.

The LOCTAGS algorithm reveals its success in grouping common sequence of two HTML documents. The comparison is performed exactly where it should be done. Even the third row of the table in [Fig. 6] is completely deleted or a new row is inserted, the HTML Difference Engine knows how to group the common tag sequence and performs comparison correctly.

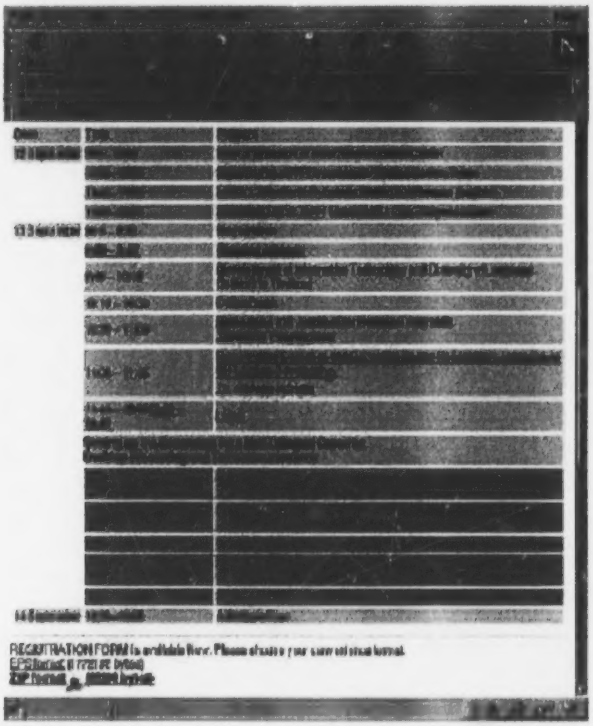

Figure 6: A result from HTML Difference Engine showing a presentation of changes in some elements of a table with the total change score of 949.

5. Conclusion

An alternative approach to detecting and displaying changes on the Web is proposed. The mobile agent community approach contributes its flexibility and efficiency to the system even in constrained environment. The approach enables open service system with less complexities and overheads. The LOCTAGS algorithm remarkably helps extraction of common tag sequence in a pair of HTML documents without complete knowledge of HTML's tag specification. As a result, the HTML Difference Engine which implements the LOCTAGS is able to present the changes in hierarchically structured text like HTML document correctly.

6. References

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A Web-based Remote Controlled Scientific Experiment System

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Abstract: One aspect of the research concerning online teaching is real time distance learning. Online teaching has focussed mainly on communicating information from the teacher to learners. In the scientific field, learners must be able to understand the content more effectively if they wish to test a theory by experiment. This paper describes an experiment system we are developing, which enables learners to operate apparatus by themselves and confirm the result via the Web.

1. Introduction

Recently, substantial research concerning online teaching is attracting our attention. One aspect of the research is real time distance learning using video-on-demand or interactive multimedia communication. Until now, online teaching has focussed mainly on communicating information from the teacher to learners, that is to say, in one direction only. Accordingly, in order that learners are able to learn more effectively, it is necessary to offer the following facilities.

1. The facility for learners to rewind scenes of an experiment if they are not able to understand the content of it.

2. The facility for learners to ask any questions if they are still not able to understand after performing item 1.

3. The facility for learners to verify the teacher's explanation through an experiment.

Concerning item 2 above [Tsutsumi and Ushijima 98], we have been conducting research on an automatic question and answer system for online teaching. Regarding item 3, we describe a web-based remote control scientific experiment system in the current paper.

2. Background

Concerning online learning, the methods of verifying the teacher's explanations through an experiment are shown below.

1. Videotape recordings of experiments already performed by teachers.
   It is difficult for learners to feel that they are really participating in an experiment simply by watching videotapes in which the experiment has already been performed by teachers. Moreover, learners are unable to change the parameters relevant to the experiment.

2. Experimental simulation software.
   This method is commonly used for a self-access system, however, the depth of learning is relatively moderate. Once more, it is difficult for learners to feel that they are really participating in an experiment simply by watching a computer simulation.

3. Experimental apparatus preparation and execution of experiments by learners at home.
   It is not realistic for learners to prepare experimental apparatus at home. Moreover, learners have to check whether their experiment was successful or not.

It seems that none of the methods can completely satisfy our needs. Therefore, we have been designing and developing a system in which learners really operate apparatus themselves and see the state of an experiment via the Web.

3. Outline of our system

The scientific experiment system is shown in Fig.1. It consists of experimental apparatus including a computer-controlled robot arm. We are able to provide experimental apparatus scenarios, e.g. concerning optics, dynamics, electricity and so forth. A learner can see our Web page using on Internet Browser, for example Netscape Navigator or Internet Explorer. On the Web page that we offer, a learner can control the experiment. Real time computer display of the experiment is seen simultaneously by other learners. At the same time, the experiment is recorded by means of the MPEG method on the server computer. Thus, learners can replay the image file on the Web. Moreover, they can change the parameters of the experiment.

As an example of scientific experiments, we are developing an optical experiment concerning a refractive index and a total reflection. A target of our system is for K4 through 8 Grade. It consists of a steel panel with an acrylic water tank and a semiconductor-laser. The laser is held in the robot arm. The tank is half-filled with water. As a learner can see an angle of incidence and reflection, a scale on the panel has 5 degree intervals.

When a learner instructs an angle of incidence via the Web, the robot arm with the laser moves to the angle of incidence. The learner can see an angle of reflection via the Web, and can easily change the angle of incidence through the Web. The learner can verify a teacher's explanation through an experiment on the Web.

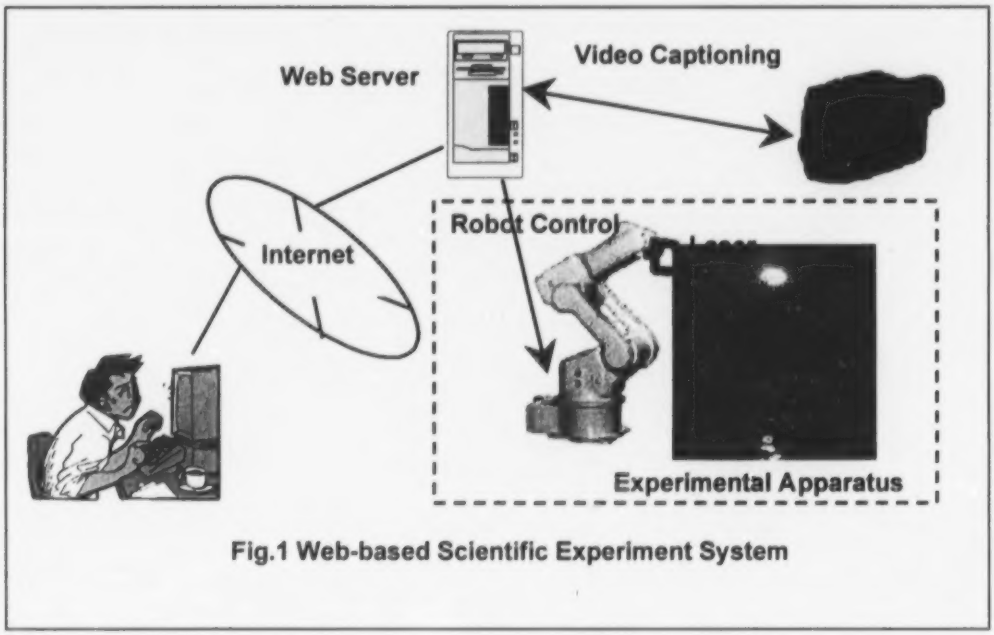

Fig.1 Web-based Scientific Experiment System

4. Discussion

The characteristics of the system are displayed below.

1. High educational effectiveness.
   A learner's experiment is real. The results can not be seen in advance. Although an experiment may not go well because the apparatus is influenced by the environmental circumstances, such as temperature, humidity and so on, learners can have insight into a subject through failure.

2. Experiment by collaboration.
   Learners distant from each other can have communication and experiment together. They can discuss an experiment with each other from their homes, which promotes better understanding.

3. Collecting experiment logs.
   Teachers and learners can check scenes after an experiment because the log of an experiment remains in an MPEG file.

4. Online teaching.
   A teacher can easily use this system for online teaching.

5. Conclusion

In this paper, we have described the outline of scientific experiments system for online teaching, in which a learner is able to control an experiment through the Web. One example of scientific experiments we are developing is an optical experiment system regarding a refractive index and a total reflection. Since we have just begun this work, we still have many aspects to research. However, this kind of system will become increasingly important as online education spreads. We expect learners to develop positive creativeness which could not be developed simply by passive online teaching. Our future plan includes supplying a variety of scientific experiments in order to use this system in actual classes.

References

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Customized Web-Based Data Presentation

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Abstract: This paper presents a language for specifying the presentation of data in Web pages. The language is an extension of HTML that includes constructs for specifying how to present one or more instances of a given class of data, and constructs for tailoring the pre s-entation to the features of the data, to information in user profiles and to the capabilities of the user's platform. We describe the architecture of the system, the features of the page specification language, and present examples of generated pages.

1. Introduction

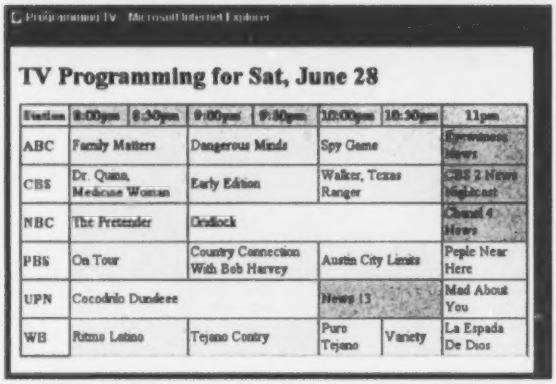
In this paper we address issues related to the dynamic generation of HTML pages. Dynamically generated HTML pages are pages whose contents are generated by software, typically by CGI scripts, or by dynamically loaded libraries that run directly in a Web server. Dynamically generated pages are often used to present data stored in databases or data produced by application programs.

Some efforts have already been undertaken in this direction. For instance, Active Server Pages (ASP), [Microsoft], mediate as a bridge between data bases and web pages, where it is possible to specify some of the required features by programming. Similarly, within the consortium W3, various guidelines have been outlined towards such a goal, like the XML language, [W3 consortium]. This language is envisaged to meet the challenges involved in large scale publications, by extending the HTML language, and allowing declarative definitions of new tags easier to follow by the user.

We concentrate on the following issues:

How to conveniently specify a page that presents any instance or list of instances of a given class data? For example, suppose that we want to construct a page to show the TV schedule for a certain period, as shown in [Fig. 1] (this page shows a list of instances of class "TV-Program"). One alternative would be to have someone type in the appropriate HTML using a text editor or a Web authoring tool such as FrontPage. This would work, but would be impractical. A similar page would have to be typed in every day. The Web site featuring these pages would be inflexible. It would not allow users to request the schedule for only certain stations or time periods. It would not be able to keep track of user preferences, and show users a schedule customized to their viewing preferences. An alternative that overcomes these problems would be to store the schedule information in a database, and write software that generates the HTML pages from the database information. In this paper we present a system that enables authors to specify such pages in a language that resembles HTML.

How to integrate static HTML with dynamically generated HTML? Most pages that display dynamic information also contain a significant amount of static HTML such as headings, explanations and pointers to related information. In traditional CGI-based schemes, even the static parts of the pages are generated by software. This is most inconvenient, because to change the static parts of the page it is necessary to change the software. An alternative approach, used in ASP, is to embed in the static HTML calls to software that generates the dynamic parts of the page. In this paper we present a system where the static and dynamic parts of the page are seamlessly integrated.



TV Programming for Sat, June 28

Station	8:00pm	8:30pm	9:00pm	9:30pm	10:00pm	10:30pm	11pm
ABC	Family Matters		Dangerous Minds		Spy Game		Eyewitness News
CBS	Dr. Quinn, Medicine Woman		Early Edition		Walker, Texas Ranger		CBS 2 News Nightcast
NBC	The Pretender		Gridlock				Channel 4 News
PBS	On Tour		Country Connection With Bob Harvey		Austin City Limits		Peple Near Here
UPN	Cocodrilo Dundeee				News 13		Mad About You
WB	Ritmo Latino		Tejano Contry		Puro Tejano	Variety	La Espada De Dios

Figure Error! Unknown switch argument.. Presentation of a TV schedule

How to tailor data presentation to the needs and preferences of each user? Many Web-sites and Web-casting stations offer users the ability to define a personalized site home-page that shows users the information that they want to see. The page authoring language we present in this paper features rules that help page authors set up user-tailored pages, and pages tailored to classes of users.

How to tailor data presentation to the capabilities of the user's platforms? Most Web pages are designed for a "typical user platform" which is usually a Wintel machine with a 256 color 14" monitor and a 28.8kb modem. The effectiveness of the page designs often degrades to the extent that the user's platform deviates from the typical platform. For example, if the screen is much smaller, users need to scroll both vertically and horizontally. We expect this problem to become much more severe in the near future with the proliferation of Web-TV class machines, different sized portable machines, and powerful Pentium workstations. The rule-based component of our system can be used to specify platform-specific tailoring of Web pages.

2. Architecture

[Fig. 2] shows the architecture of the system. Our system, labeled Presentation Agent (PA), is invoked by the Web-server when it receives a request for a file with extension DPML (Data Presentation Markup Language). The system is written in Java, and we use the Java Server Development Kit for the server part. Upon receiving a request, the PA performs the following actions:

1) Read the user profile, if one exists for the user identified in the HTTP request.
2) Read the DPML file and build a tree of presentation objects that represents the structure of the HTML document to be generated. For each presentation object perform the following steps (the steps will be explained in more detail in the sections below):

a) Read the meta-model files for the classes of data referenced in the DPML file.
b) Fetch the data needed to construct the presentation. The meta-model files tell the PA where to fetch the instances of each class. Both relational databases and ASCII files are supported. In the case of relational databases the meta-data file contains the SQL queries needed to fetch the attributes of an object. Our example uses ASCII files.
c) If the data to be presented is a list, replicate the corresponding node in the tree as many times as there are elements in the list. For example, this occurs for lines 18 and 24 in [Fig. 4]. The tr presentation object (line 18) is replicated as many times as there are TV stations. The replication makes a deep copy of the tree, so the embedded td objects (line 19 and 27) are also replicated for each TV station. For line 24 each td replica is again replicated, this time for each program that the station offers on the given day.

3) Once the complete tree of presentation objects is instantiated, the PA applies the style rules. The style rules can set the properties of each object such as the color, font, etc. The rules can test attributes from the HTTP request, properties of the data, and attributes from the user profile.

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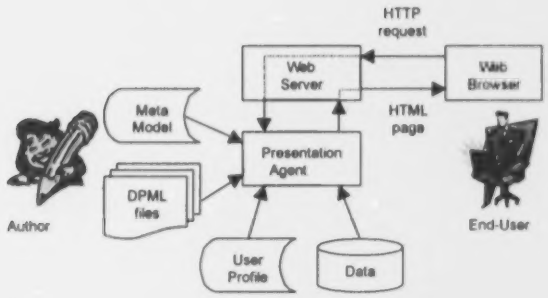

Figure 2. Architecture

4) Finally, the PA generates HTML and sends it to the Web-server, which sends it back to the Web-browser.

3. Meta-Model

Our meta-modeling language is a very simple data description language designed to support two PA needs. First, meta-models, define the format for shipping data from a database or application program to the PA. In addition to relational database connectivity, we support a simple ASCII format that is easy for applications to generate. Second, meta-models give authors the means to associate arbitrary meta-information with the object definitions. Authors are expected to develop the meta-model and a collection of presentations (DPML files) together. If they need some piece of information about a class of objects in a DPML file they can define a property in the meta-model to represent it.

```
1. LongMetaData Duration { units="half hour" }

2. ObjectMetaData Program {}
3. [   name(Name) {}
4.     duration(Duration) {}
5.     kind(Kind) {} ]

6. ObjectMetaData Station {}
7.[   stationName(Name) { attributeName="Station" }
8.   programs(Program) { multiValued="yes" } ]

9.ObjectMetaData Schedule {}
10. [   day(String) {}
11.    times(String) { multiValued="yes" }
12.    programming(Station) { multiValued="yes" } ]
```

Figure 3. Meta-model specification

[Fig. 3] shows the meta-model specification for our TV schedule example. Line 1 shows the specification of a primitive meta-object. Duration is a number that represents the number of half/hours that a program lasts. We encourage authors to define their own meta-objects for the primitive types of their application domain. This is useful because authors can associate style rules with meta-objects to specify properties of their display.

Lines 2, 6 and 9 show the specification of some structured objects. Line 2 defines the meta-object Program as having three attributes (name, duration and kind). Each attribute has a name, a type (specified in parenthesis). Single inheritance between structured meta-objects is supported. The meta-object Station has the name of the station, and a list of the programs that a station will show in a given day. Finally, a Schedule specifies the day and time covered by the station, and a list of stations for which the schedule object has information.

The meta-modeling language allows authors to associate any properties they want with meta-objects or with attributes. These properties are often referred to from within DPML files. For example, line 11 in [Fig. 4]

refers to the AttributeName property of the Station meta-object. This property specifies the label that appears in the top-left corner of the table shown in [Fig. 1].

4. DPML Files

DPML files (Data Presentation Markup Language) specify the HTML code that the PA generates to present a collection of data objects. DPML is a superset of HTML. This has several benefits. First, authors do not need to learn a new specification language from scratch. They must only learn our additions to HTML. Second, static and dynamically generated HTML are completely integrated: authors can embed presentations of data within static HTML, and can also embed HTML within the presentations of data.

The basic idea in DPML is to allow authors to extend HTML specifications with expressions that fetch values from an object or its meta-data. When the PA processes the DPML file, it substitutes these expressions by the values that they return. Also, as mentioned in step 2a) of the PA presentation algorithm in the previous page, when an expression returns a list of objects, the corresponding HTML tags are replicated. The rest of this section describes the DPML extensions to HTML in more detail.

```
1. <html>
2. <head>
3. <link    type=text/css rel=stylesheet
4.  href="http://erastus.isi.edu/MIPGenerator/CSS/TvStyle.css">
5. </head>
6. <div object='?schedule in tv:Schedule.instances()'>
7. <h1>TV Programming for <value ?schedule.day></h1>
8. <table border=1 cellspacing=0 cellpadding=2>
9. <tr>
10. <th>
11. <data tv:Station.stationName.getProperty(attributeName)>
12. </th>
13. <th    object="?time in ?schedule.times"
14.         bgcolor=PowderBlue>
15. <data ?time>
16. </th>
17. </tr>
18. <tr object='?s in ?schedule.programmings'>
19. id
20.    style-rule= 'color alternates ("SaddleBrown", "Indigo")
21.                  when ?s.stationName changes'>
22. <data ?s.stationName>
23. </td>
24. <td        object='?p in ?s.programs'
25. style-rule='colspan=?p.duration'
26.            class=?p.kind>
27. <data ?p.name>
28. </td>
29. </tr>
30. </table></div></html>
```

Figure 4. DPML specification for the TV schedule presentation shown in [Fig. 1]

DPML allows authors to declare variables to hold the data to be presented, and expressions that specify how to compute the values for them. DPML supports three types of variables: variables of type *object* hold instances of objects to be presented, variables of type *meta-data* hold the meta-data of an object, and variables of type *attribute* hold the names of attributes of structured objects. Variables can hold either a single value or a list of values.

For example, line 6 in [Fig. 4] defines an object variable called ?schedule, whose value is the list of all instances of the meta-object called Schedule in the name-space called tv. There is a structured representation of all the meta-data into various name-spaces, each one holding the data referred to the same semantic context. Thus, each time the PA needs to fetch the data, it retrieves the necessary values from the corresponding name-space.

The expression language also supports filtering and sorting qualifiers. These are not used in our simple example, but these qualifiers can be used to select subsets of data objects and attributes to be presented, and to specify the order in which elements of a list should be displayed.

When filtering data objects, a specific language can be used to represent predicates on data objects. For instance, in the example shown in this paper, an expression such as "object='?p in ?s.programs where ?p.duration>2" could be considered. Likewise, sorting declarations allow the selection of a given sequence of objects to be displayed.

The data tag is used to specify that the value of a variable or an expression should appear in the generated HTML. The syntax of the value tag is <data *expression*>. The PA will evaluate the expression, convert its value to text, and output it in the stream of generated HTML. For example, in line 27 the specification <data p.name> produces the name of a program as the contents of a cell in the table.

In case the evaluation of an expression returns a non-primitive object, it is not clear what the conversion to text should be. In this case, *substitution rules* can be applied to determine a detailed DPML expansion of such an object. Suppose the expression "<data ?schedule>" appears within a DPML file. In this, the DPML language allows the specification of rules that define the way this kind of object is to be converted to DPML and, eventually, HTML objects.

A generic substitution rule consists of a condition on an object data, and an action that is a piece of DPML code. Such code is to replace an expression like the above one. Thus, programming is additionally supported in DPML files, being possible to take into consideration the specific properties of the data, the user profile, and the platform, as appropriate.

Now, lets take a closer look at how the above DPML constructs are used to specify the display shown in [Fig. 1]. The complete DMPL specification is shown in [Fig. 4]. We will postpone the explanation of the style rules until the next section.

Lines 1 through 5 are standard HTML. Line 6 is the first HTML tag that uses a DPML extension. The div tag is an HTML tag that defines a section of a document. It does not produce any output, but serves as a placeholder to include style information. In our example we use it to specify the root object of our presentation. Line 6 declares variable ?schedule and binds it to the list of instances of meta-object Schedule. In our example we only have one instance. Should there be more than one, the output would contain a heading and a table for each instance of Schedule.

Line 7 defines the heading that appears above the tables. It illustrates how HTML and DPML can be freely mixed within a specification. The heading consists of the words "TV Programming for" followed by the value of the expression ?schedule.day, which is "Sat, June 28".

Line 8 introduces the table. Lines 9-17 define the table headings. Line 11 produces the text "Station" as explained in the previous section. Lines 13-15 produce the headings "8:00pm" through "11pm".

Lines 18-29 specify the rows of the table. Line 18 specifies that there should be a row for each value of the programming attribute of the schedule. Recall that this produces the list of all Station objects that we wish to present. The first column of the table (lines 19-23) shows the name of the station. The other columns show the programs that will be aired. Note how the colspan attribute (line 25) is defined with an expression so that programs that last more than half an hour occupy more than one column.

5. Presentation Tailoring

Our system supports three different mechanisms to tailor the format of presentations: style-rules, conditional tags and cascading style sheets (apart from the substitution rules described above).

1) STYLE RULES are condition/action pairs. The condition part specifies the situations when the rule should be applied, and the action part specifies values for HTML attributes. Our example does not contain an instance of a style rule with a condition part. Such rules are used to express something like "if price>200 then color=red".

The rule in lines 20 and 21 illustrates a more complex action. This rule specifies that the color of the station label shown in the first column of the table should alternate between SaddleBrown and Indigo.

The difference between style and substitution rules lies in the action to be performed. The latter has a more complex action and, in fact, a style rule is a particular case of a substitution rule where the action appears close to the tag where it is to be applied, and it contains HTML attributes to be assigned to a certain tag.

2) CONDITIONAL TAGS allow authors to specify a boolean expression to decide whether a whole fragment of HTML should be included in the output (i.e., <tag condition='boolean-expression'>contents</tag>).

If the boolean-expression evaluates to true, the contents of the tag are processed, and the HTML it produces is sent to the output stream. If the condition is false, the contents are skipped, as if the whole tag had not been present.

3) CASCADING STYLE SHEETS (CSS) are an HTML extension under consideration by the W3 consortium. CSS allow authors to declaratively specify in a separate file the appearance of every HTML tag. In our example we use style sheets to specify the color of each cell according to the category of program (line 26). The css file specified in line 3 specifies the colors to be used.

The PA allows authors to make extensive use of cascading style sheets. The PA automatically defines a CSS class for every meta-model object and attribute defined in a meta-model file. The generated HTML includes the appropriate style-sheet invocations. For example, the HTML generated for line 18, where the rows of the table are defined is <tr class=Station>. The style sheet file can then contain style sheet definitions of the form .Station {background=yellow}, which cause every tag that includes the Station class to have a yellow background.

6. Related Work

CGI scripts are the most common technique to dynamically generate HTML pages. CGI scripts offer developers complete flexibility and the ability to program arbitrary mapping from data to HTML. However, writing CGI scripts is beyond the skill of many Web publishers. The DPML language provides a much more accessible alternative, and provides sufficient power to generate a wide range of pages.

DPML was inspired by Active Server Pages (ASP), [Microsoft]. ASP, like DPML, allows specifications for data presentation to be embedded within HTML text. The difference is that, in ASP, the specifications must be written in a programming language (VBScript or JavaScript). The DPML language is higher level, leading to more succinct and easy to write specifications.

DPML also borrows ideas from model-based user interfaces, [Szekely et al. 1993] [Vanderdonckt 1996]. Specifically, the replication and conditional constructs are based on similar constructs found in Humanoid and Mastermind. The notion of style rules comes from ITS, [Wiecha et al. 1990], whose major feature is the support of multiple, rule-based user interface styles through a declarative statement of such goals. The main difference with these systems is that DPML provides a much more accessible language for specifying the models.

Within this stream of tools that support the representation of data in WWW, there have also been remarkable trends over the last years. Specifically, WDB, [Rasmussen 1995], provides a software tool-set that simplifies the integration of SQL databases into WWW providing access to the contents without writing any code. CATALOG, [Martinez and Moran, 1996], is another system that creates WWW pages from databases by using a declarative specification which does not require any programming skill for such a task. However, DPML provides much more flexible capabilities when integrating data into WWW pages.

7. Summary and Future Work

The work reported in this paper represents the first step towards a system that meets the goals outlined in the introduction. We have written meta-models and DPML for three small domains, and are about to embark on the creation of larger examples. In the future we want to enhance the rule language to allow rules to transform the HTML tree being generated depending on presentation conditions for each particular case. The goal is to implement heuristics that improve the presentation of data depending on user preferences, platform characteristics, or dynamic aspects of presentations. Another goal is to enhance DPML to support the specification of user interfaces implemented in applets embedded in WWW pages.

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Tracking Web User Behavior using Event Hooks

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Abstract: This paper proposes a method of precisely tracking the behavior of web users in detail. A special library inserted into the web browser captures events occurring inside and outside the web browser and converts them into useful usage information. This method can obtain necessary and sufficient data about web users ' behavior without modifying the browser or other libraries.

Introduction

As the Internet population increases and marketing activities via the web become popular, there is a growing need for a high-quality method of tracking web users to improve the web industry. Important application domains of web user tracking include:

- Audience Measurement and Auditing: to provide reliable and accurate indexes on web effectiveness, advertising value, and market trends (mainly for content providers and advertisers)
- Marketing Research: to help understand web usage trends like the number of page views and to support decision-making on future site strategy (mainly for webmasters)
- Personalization and Targeting: to collect data on every user's behavior to improve personalized services such as information retrieval, recommendations, and customization (mainly for users)

Necessary Data

User behavior on interactive media is usually recorded as a "clickstream", which has been defined as a chronological series of data created by time-stamped events enacted via input devices [CASIE 97]. In the case of the WWW, to get typical numbers such as the number of visits, page views, and hits, it is enough that each record in a clickstream should include only the identifier of the visitor and the URL of the page. However, for comprehensive analysis there are many cases where more detailed information is needed as follows.

- *Page Transfer Action*: the route taken to reach to a page (e.g. via hyperlink, bookmark, or direct entry of the URL), which is helpful to marketers in planning site promotion
- *In-page Action*: the type of action on a page (e.g. print out or register a bookmark), which indicates whether a user is truly interested in the contents
- *Reading Time*: the time spent reading a page, which is regarded as the best measure on the web as it does not depend on the page structure or type of contents
- *Response Time*: the time taken for a requested page to be displayed, which is useful to webmasters and to ISPs for improving traffic performance

Traditional Approach and Issues

Various web user-tracking methods can be categorized according to whether the measurement is performed at (A) servers, (B) intermediate servers or (C) browsers [Brown and Benford 96]. Intermediate servers include proxy servers, cache servers, and routers. In this paper, we focus on only the browser-side approach because our concern is getting more detailed behavior information as described above.

Browser-side tracking can be categorized into two methods:

(C-1) Interaction with browser: Many operating systems provide an inter-process communication mechanism for a process to control or to monitor other processes. When a process sends an inquiry to a web browser process according to a specific protocol, the browser returns the current status.

(C-2) Modification of browser: By modifying a browser at the source code level, one can enable the browser to trace actions and record status in a file by itself.

The first method is cheaper to develop, but provides limited information. We cannot obtain data related to actions or time periods described in the previous section. The second method provides unlimited data, but the cost is quite high. We have to modify many kinds of browsers and re-deliver modified versions to all

measuring places every time browsers are upgraded. We propose a hybrid approach, which has both advantages.

Proposed Solution

The basic idea is hooking events by inserting a special tracking library into the executing browser process. When a web browser is executed by users, a daemon process orders the browser to load a special tracking library together with the regular libraries. This new library always watches the browser's action and captures events inside the browser and events between the browser and other processes or the operating system. Then the special library filters the raw events, interprets them according to the browser own conversion table, and converts them to useful usage data. The daemon process receives the results from the tracking library and writes them into a history file [Figure 1]. This method enables us to obtain necessary and sufficient data regarding web user behavior without modifying browsers or common libraries. For example, *Page transfer actions* are generated by comparing the page shown on the browser with events that come from input devices through OS. *Response time* is generated by recording when send and receive functions were called.

This method is so general on a multi-processing system that it can be easily applied to other applications simply by updating the conversion table. Recently less-interactive media like push services have become popular. It would be difficult to understand the total behavior of users in a mixed environment without using a general tracking method like this.

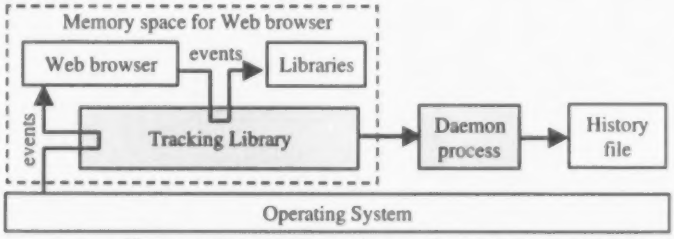

Figure 1: Proposed tracking method using event hooks

Development and Experience

We implemented a prototype system named "InfoGather" which runs on Windows OS and targets both MS Internet Explorer and Netscape Navigator. Each record in History file has the URL, title, *Page transfer action*, and *Reading time* and can be identified by terminal ID, window ID, and time of occurrence. The system has two functions: "Message hook" to capture events between the browser and OS and "API hook" to watch the browser's use of the libraries. The "Message hook" enables to detect twelve possible types of *Page transfer action* as well as the history of URLs. The "API hook" enables to detect the *send* function call of the TCP/IP communication library (wsock32.dll) and can get the history of all requested files including embedded URLs.

We tested this prototype on public computers at an exhibition and confirmed the usage data amounting to 10,000 page views was captured efficiently. A breakdown of pages by *Page transfer action* is shown in [Table 1]. Page transitions by hyperlink were just over half of all accesses. This result (56%) is in good agreement with the value obtained by Catledge's study (52%), although methods for classifying actions are different slightly [Catledge and Pitkow 95].

Action	Number	Percentage	Description
Hyperlink	5532	56%	Select hyperlink in page
Move	2375	24%	Click back or forward button or use history function
Re-focus	1098	11 %	Return to the page after using another application or window
Designate	274	2.8%	Go to a designated site by clicking a special button integrated in the browser
Home	144	1.5%	Click the home button
Key-entry	98	1.0%	Type the URL address directly into the address field
Bookmark	91	0.9%	Use a bookmark, hotlist or favorite list function

Table 1: Breakdown of pages by *Page transfer action*

Conclusion

Our new method for tracking web users' behavior in detail using event hooking can gather reliable and

sufficient web usage data in an efficient manner and can be easily applied for tracking many applications besides web browsers with only minor modification.

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HOLD THE JAVA! SCIENCE ACTIVITIES VIA NETWORKED MULTIMEDIA CD-ROM'S

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Abstract

The potential for Java applications to bring educational multimedia to K-12 classrooms is sometimes limited by the realities of hardware and networking. In response to teacher concerns, the One Sky, Many Voices [http://www.onesky.umich.edu/] program has developed a series of networked multimedia CD-ROM's to support its Internet science activities. This format allows delivery of rich interactive activities containing animation as well as real-time information. Additionally this format allows users to use archived information in the event their network connection is unavailable for class.

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This new tool provides:

- Internet access to current weather maps
- The ability to overlay additional fields to investigate interrelationships,
- A drawing function to allow annotation of maps
- A printing function for all images
- Communication of usage statistics directly to research database

This approach offers new opportunities for educational research and is an accessible medium for development of educational multimedia. An example of this program can be obtained at http://www.onesky.umich.edu/kgs98/download.html.

INTRODUCTION

The *One Sky, Many Voices* (OSMV) project [http://www.onesky.umich.edu/] reflects current thinking about how students learn best with emerging technologies that both make intelligent use of Internet resources and acknowledge the realities of classroom resources. Our educational challenge is to create and distribute coupled curriculum and technologies that will enhance the learning opportunities of middle school students through exploration of real-time weather phenomena. Our content challenge is to provide the real-time information with dynamic exploratory stimuli and explanatory support. Our technological challenge is to provide tools which provide a rich and stimulating environment for exploration while being sufficiently reliable even in the event of network outage.

The OSMV project is a collaboration of the *Kids as Global Scientists* program (Songer et al., 1996) *and The Weather Underground* project [http://blueskies.sprl.umich.edu/]. The latter project has worked to develop new technological approaches to exploration of weather information. Initially this effort resulted in the development of one of the first telnet based weather information systems [telnet://mammatus.sprl.umich.edu:3000]. Second, the Weather Underground created *Blue-Skies* [http://blueskies.sprl.umich.edu/BS.html], a Gopher-based software client, created prior to the development of World-Wide Web browsers, which provides truly interactive weather maps. Third, the project maintains a complete set of weather-related web sites including *WeatherNet* [http://cirrus.sprl.umich.edu/wxnet/], a table of contents for worldwide weather information.

While all these resources serve the educational community in both programmatic curriculum developed by the Kids as Global Scientists program and independent classroom activities, we have learned from our experience that the limitations to their use result from at least four issues:

1• Connectivity in classrooms is not sufficiently reliable to allow teachers to count on Internet resources;

2• Classrooms are often lack a sufficient quantity of Internet-connected computers to provide whole class access;

3• Teachers in middle school and lower often have not had training in weather issues and need to be supported in Internet activities; and

4• Internet resources are rarely designed in collaboration with educational curricula, which address classrooms' needs to support state and national science learning objectives.

This paper addresses our coupled content/technological approach to items 1-3. The project approach to item 4 is contained elsewhere (Songer et al., 1996).

AN ALTERNATIVE TO BROWSING

The strength of the World Wide Web is its power to deliver enormous volumes of information through user defined queries. Classroom activities may take advantage of this through open exploration and/or guided inquiry delivered by specific resource and curriculum sites. While for many activities the ability to browse can lead to active exploration by the student, too often the information obtained provides minimal supporting explanation or the supporting explanation is at a level inappropriate for the student. Thus the user's experience may not result in the desired level of learning. Likewise, the exploratory strength of browsers also can lead to off-task inquiry that distracts the student from reaching their learning objectives.

Second, the reliability of Internet connections, while improving, is still not sufficiently robust to support scheduled classroom activities in many situations. Hardware and software failures, unavailable dial-in access, and server failures are among the issues that may prevent a classroom from successfully participating in a scheduled Internet activity.

To address these concerns the One Sky, Many Voices program created networked CD-ROM's which support our curriculum by providing real-time but prescribed weather information from the Internet (Figure 1). These information are selected by content experts in meteorology in collaboration with education specialists. The real-time imagery and information is supported by linked multimedia explanations on the CD-ROM. Education and content guidance is delivered to the user through the CD interface.

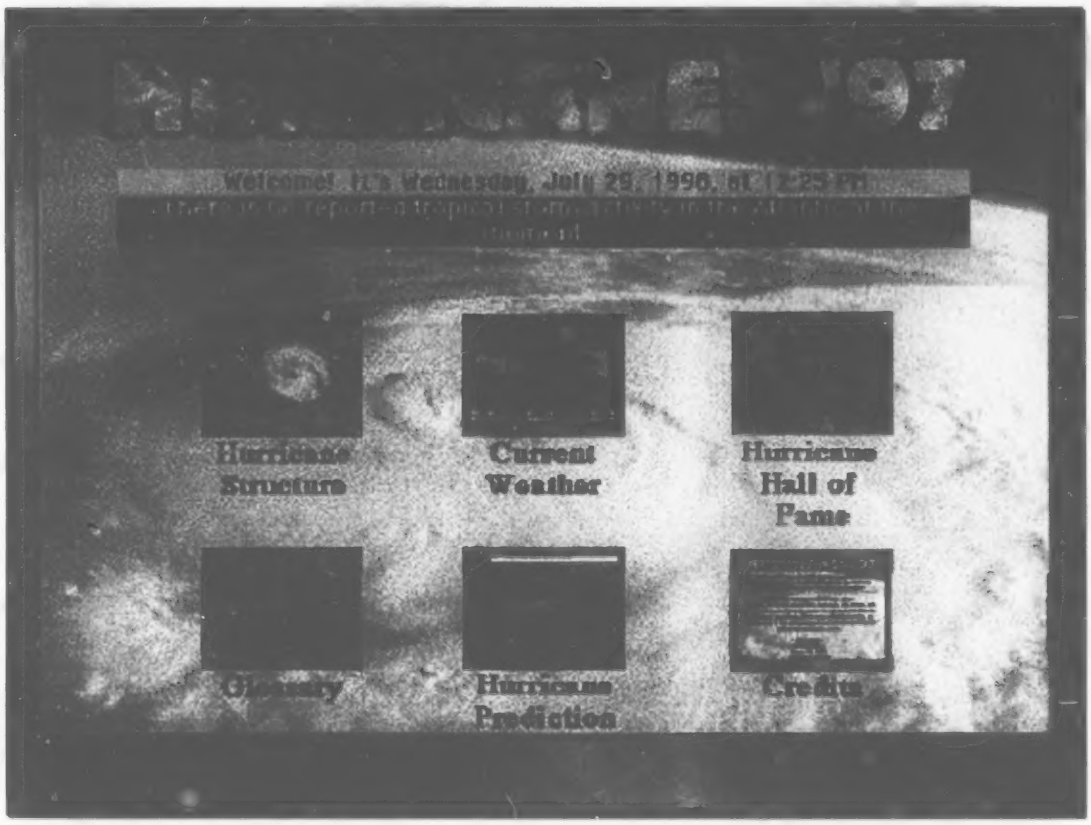

Figure 1. Illustration of navigation page for Hurricanes'97. Note that by the time the program has reached the initial screen it has already checked a weather server to see if there is a current tropical storm in the Atlantic.

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Activities have varied from curriculum to curriculum but the model has been to build a knowledge base through active exploration that leads to a prediction activity. In Hurricanes'97, for example, the students were provided archived hurricanes and tropical storms as well as a "fly-through" hurricane. These resources lead the student to understand the morphology of a hurricane and the conditions which lead to hurricane intensification and decay.

This construction of a knowledge base was followed by an activity where students were to predict the motion of either an archived tropical storm or, had nature provided, a live hurricane. The design would have allowed participating students to forecast which cities on the east coast of the United States should receive hurricane watches or warnings.

NETWORKED CD-ROM DESIGN

The selection of CD-ROM multimedia was based on the observation that combining technologies provides important features for the educational community (Table 1).

TABLE 1. BENEFITS OF COMBINING TECHNOLOGIES

Internet Affordances	CD-ROM Affordances
• Current information	• Lower memory demands than Java-enabled browser
• Communication	• Archived information for non-networked or broken networked situations
• Contributions of students incorporated into program	• Rich content including interactive images, animations, sounds
• Worldwide scope	• Easy distribution of large programs and data files

The quality of a networked CD-ROM for educational purposes is judged by its ability to meet its educational goals within predefined technical constraints. At the outset it is necessary to define the typical user, the expected frequency of use of the CD-ROM resources, the network demands inherent in use of the program and what level of customization was desirable for the student. Table 2 lists, as an example, the criteria used to design the Hurricanes'97 CD-ROM.

One of our overriding design constraints is to keep our technology accessible to the widest possible population of classrooms. The memory demands of this system have been kept smaller (~8 MB) than is typically needed for a Java-enabled browser. Moreover the system anticipates needed imagery and data and preloads much of the information into a cache. To conserve bandwidth we have designed[1] the imagery to be limited to 256 colors.

APPLICATION

The CD-ROM tests whether network capability exists by searching for a file on our server. If the attempt times-out the network is assumed to be unavailable and further communication attempts are canceled. If the initial

[1] Authoring was performed using Macromedia Director™ on Macintosh™ platforms and ported to Windows'95™ and Windows 3.1™. Using Lingo™ scripting we were able to affect overlays of weather images, hence allowing wind fields to be superimposed by the user on satellite and temperature base maps.

file is successfully returned the file contains information on the existence of tropical storms in the Atlantic. This information is transmitted to the user on the opening navigation screen so they can choose to explore real-time imagery. Likewise the Hurricane Prediction game is switched to a live mode to facilitate forecasting the current storm.

TABLE 2. DESIGN CONSIDERATIONS FOR HURRICANES'97 CD-ROM.

Project	Hurricanes'97
Goals	1. Provide access to real-time weather imagery in support of Hurricanes'97 curriculum activities. 2. Support important concepts with interactive multimedia examples. 3. Provide prediction tool wherein user would be forecasting hurricane movement for either archived or "live" tropical storm track.
Creative Considerations	1. Provide virtual fly-through of hurricane with capability for user to record weather observations in order to build conceptual model of hurricane from this experience. 2. Provide creative interactive animations to build understandings of complex concepts such as the Coriolis Force, pressure gradient, and others.
Technical Considerations	1. End users have range of computer facilities available so application size must be kept minimal. 2. Users also will typically have lower connectivity speeds so imagery size must be kept modest.
Target Audience	Students in 3rd through 9th grades accessing the Internet either from classroom settings or at home.
Frequency of Use	Specific parts to be used at specific times during the four week curriculum .
Attention Factor	This is a captive audience, no need to call attention to the screen. In fact, extraneous sounds or animations might be distracting in a classroom setting.
Customization	Users should be able to overlay different meteorological fields in order to analyze and forecast hurricane motion.

At the same time information is transmitted from the CD-ROM to our server identifying when the software was started, which sections are accessed, and whether the program terminates normally. These data are stored in support of our research on technology utilization.

SUMMARY

Internet-savvy CD-ROM's offer a valuable alternative to building educational software in support of science education. The ability to include real-time information embedded in a rich multimedia environment offers curriculum designers new options for authoring. The advantages of this approach include the ability to include case studies of real-time information, high bandwidth multimedia without long download times, and prescribed access to Internet resources keeping the students on task in a focused learning environment. It is our expectation that this approach holds promise for a wide range of science learning initiatives, particularly where real-time information can play a vital role in the learning process.

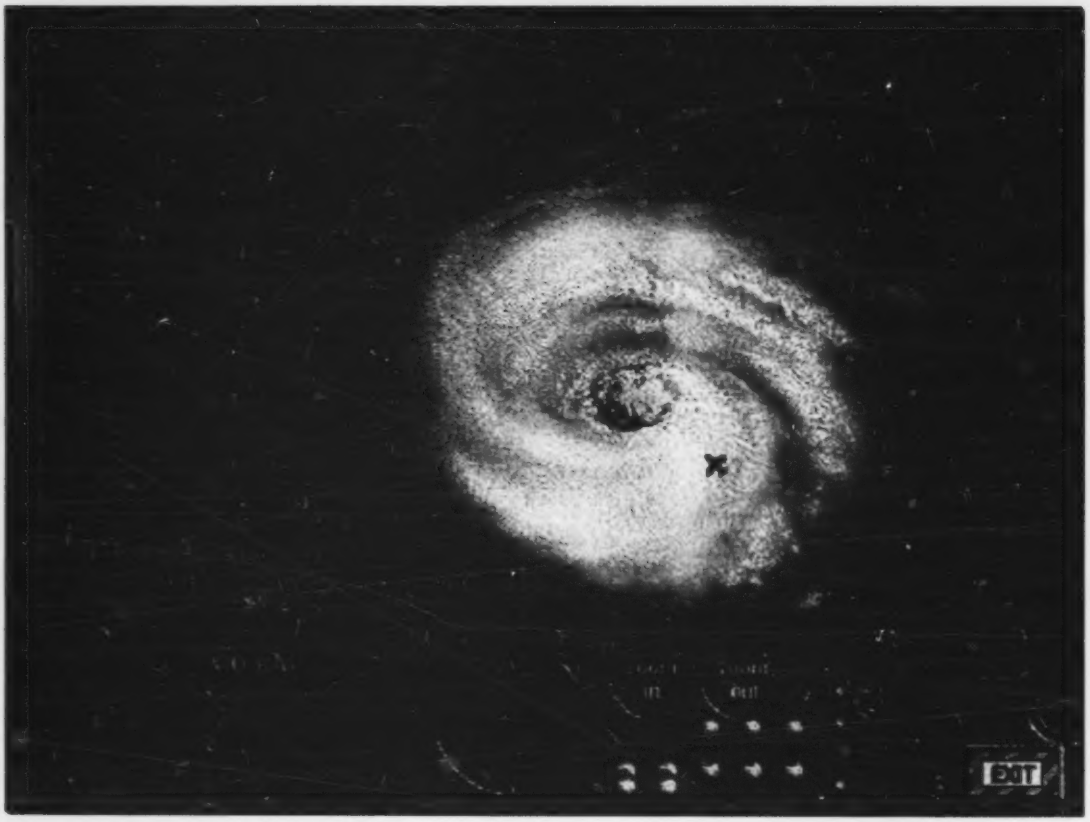

Figure 2. Illustration of hurricane exploration portion of Hurricanes'97 CD-ROM. In this section of the CD-ROM the student is challenged to define a hurricane based on their observation of hurricane characteristics.

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Evaluation Scale of Educational Web Sites

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Abstract: As a result of the present work the criteria for evaluating educational Web sites have been worked out. A special Evaluation Scale considering curriculum guidelines have been developed. The presented Scale is supposed to be applicable in evaluation of different types of educational Web sites. It consists of three parts: composition of the site, pedagogical aspects and curriculum-related aspects. The first part - composition of the site - is divided into three units: general characteristics, presentation and illustration of information and user's i m-pression. 27 teachers who had previously passed an advanced in-service course in usage of computers in school biology formed an expert group. They examined and evaluated two educational Web sites - "Estonian Vertebrates" and "Arthropods". Teachers ranked 43 different statements in the Evaluation Scale according to their opinions of the presented Web sites. The analysis of their answers demonstrated the advantage of "Estonian Vertebrates" in some as-pects compared with "Arthropods".

Introduction

There are numbers of educational recourses available on Internet varying in their composition and contents. Some of these have been assigned to educators, the others directly to basic or secondary school students. Several textbooks provide information about the composition and design of effective instructional Web site (e.g. Edwards & Holland, 1994; Boyle, 1997); some of these include curriculum context (e.g. Jones & Scrimshaw, 1988; Ross & Scanlon, 1995). The efficiency of application of educational Web sites in learning process depends on many aspects. Therefore, it is essential to clarify all the evaluation aspects related to the educational Internet resources. Obviously the same criteria can be considered both in creating effective instructional Web site and in the evaluation of educational resources available on Internet. As a minimum, the evaluation process must take into consideration technical and pedagogical aspects. A good example connecting two mentioned aspects can be examined on Internet (Jones, 1998). However, the evaluation of educational Web pages must also include the curriculum- and subject-related aspects.

Evaluation Scale

We selected three different groups of questions essential for evaluating an effective educational Web site: composition of interface, general pedagogical considerations and applicability in curriculum context. According to this the proposed Evaluation Scale of educational Web Site consisted of three parts: composition of the site, pedagogical aspects and curriculum-related aspects. Each question was presented as a statement. Teachers had to evaluate all the statements using the five-point scale, where the value of 1 corresponded to complete disagreement and 5 - to complete agreement. They could choose 0 when they could not evaluate the statement or find the answer.

The first part of the Evaluation Scale - composition of the site - is concerned with general characteristics, presentation and illustration of information and user's impression. This part can be titled as the Web-based Design Scale and was adopted from Jones (1998).

The first unit of this part embraces general characteristics. The target audience and the objectives should always be taken into consideration in composing educational Web site. Everybody starting to examine the educational Web site must get a quick survey of the orientation and the scope of the site. Similar design principles, suitable navigation devices and appropriate layout enhance finding information and thereby facilitate the learning process. Obviously there are some differences in the application of instructional Web site between the students of basic and secondary school.

I. Composition of the Site

A. General Characteristics

1. It is easy to open the program. (1-2-3-4-5 0)
2. The objective of the site is clearly presented. (1-2-3-4-5 0)
3. The target audience of the presented material is clearly comprehensible. (1-2-3-4-5 0)
4. It is easy to estimate the scope of the presented information. (1-2-3-4-5 0)
5. The site is a complete unit. (1-2-3-4-5 0)
6. The layout of all the presented material is appropriate. (1-2-3-4-5 0)
7. The same design principles are used. (1-2-3-4-5 0)
8. The navigation in the site is easy. (1-2-3-4-5 0)
9. The navigation devices are suitable for basic school students. (1-2-3-4-5 0)
10. The navigation devices are suitable for secondary school students. (1-2-3-4-5 0)

The second unit of the first part concentrates on the presentation and illustration of information. Design of the front page must be attractive and all the information on it clearly understandable for the learners. The appropriate structure of hypertext, illustrations, sound, video and animation must form a complete unit. All these aspects enhance the presentation of information and overall the effectiveness of the application of educational Web site.

B. Presentation and Illustration of Information

11. The front page is reasonable and comprehensible. (1-2-3-4-5 0)
12. The layout of the text supports reading. (1-2-3-4-5 0)
13. The appropriate font is used. (1-2-3-4-5 0)
14. The colors of the text are reasonable and consistent. (1-2-3-4-5 0)
15. The quality of illustrations is good. (1-2-3-4-5 0)
16. The photos enhance the presentation of the information. (1-2-3-4-5 0)
17. The figures enhance the presentation of the information. (1-2-3-4-5 0)
18. The audio enhances the presentation of the information. (1-2-3-4-5 0)
19. The video enhances the presentation of the information. (1-2-3-4-5 0)
20. The animation enhances the presentation of the information. (1-2-3-4-5 0)

The user's positive impressions increase the learner's interest to the subject and therefore increase the learning motivation. According to this there were some questions about user's impressions in the third unit of the first part. However, the opinions of evaluators might be different - teachers and students are not always of one mind.

C. User's Impression

21. The site is engaging and invites to use. (1-2-3-4-5 0)
22. The site is composed creatively. (1-2-3-4-5 0)
23. The site is well done. (1-2-3-4-5 0)
24. The site is enjoyable. (1-2-3-4-5 0)

The second part of the Evaluation Scale rates several attitudes on educational philosophy, goal orientation, motivation, metacognitive support, and advantage of learning strategies and structural flexibility. All these aspects must be considered in designing an effective educational Web site (Reeves & Reeves, 1997; Philips, 1997). The evaluation of pedagogical aspects presumes the appropriate educational background. Therefore, teachers were provided with some additional explanations in our case study.

II. Pedagogical Aspects

25. Pedagogical philosophy (instructivist - constructivist). (1-2-3-4-5 0)
26. Goal orientation (sharply focused - general). (1-2-3-4-5 0)
27. Source of motivation (extrinsic - intrinsic). (1-2-3-4-5 0)
28. Teacher's presence in using of the site (not necessary - obligatory). (1-2-3-4-5 0)
29. Metacognitive support (does not provide feedback - provides feedback). (1-2-3-4-5 0)

30. Collaborative learning strategies (unsupported - supported). (1-2-3-4-5 0)
31. Structural flexibility (fixed - open). (1-2-3-4-5 0)

The third part of the Scale embraces curriculum-related aspects. In this part an essential group of questions includes the relation of educational Web site with the concepts of Estonian new State Curriculum. However, the same guidelines can be found in the curricula of the most countries. We were interested if the presented Web site is applicable in teaching various themes of curriculum, but also in extra-curriculum activities. One obvious prerequisite for successful usage of instructional Web site is that all the texts and presented materials are correct in its content and comprehensible by the users. The application of some instructional Web sites might be accompanied with supplementary materials. Therefore, this aspect was also under consideration.

III. Curriculum-Related Aspects

32. The site is related to the themes of the curriculum. (1-2-3-4-5 0)
33. The site is applicable while teaching various themes of curriculum. (1-2-3-4-5 0)
34. The site is also applicable in several extra-curriculum activities. (1-2-3-4-5 0)
35. The presented material is correct in its content. (1-2-3-4-5 0)
36. The content of the information is comprehensible for basic school students. (1-2-3-4-5 0)
37. The content of the information is comprehensible for secondary school students. (1-2-3-4-5 0)
38. The formulation of texts is well adapted to basic school students. (1-2-3-4-5 0)
39. The formulation of texts is well adapted to secondary school students. (1-2-3-4-5 0)
40. There are lots of incomprehensible terms in the topics. (1-2-3-4-5 0)
41. All the terms are well explained. (1-2-3-4-5 0)
42. The material of the site is applicable without supplementary materials. (1-2-3-4-5 0)
43. The material of the site is usable in computerized biology classes. (1-2-3-4-5 0)

Educational Web Sites

Two educational Web sites have been examined in the evaluation process - "Estonian Vertebrates" and "Arthropods" (Fig. 1). The first one has specially been composed for basic and secondary school students in our Department. It considers the guidelines of Estonian new Sate Curriculum (Sarapuu, 1997). The second one - "Arthropods" - has been designed in the Institute of Zoology and Botany (Estonia). In developing the latter no special efforts towards the curriculum content were done.

The main part of "Estonian Vertebrates" Web site (*http://sunsite.ee/loomad/*) is a database about five groups of Estonian vertebrates: fishes, amphibians, reptiles, birds and mammals. It includes general information about vertebrates, lists of all the species of Estonian vertebrates and survey of all the groups emphasizing the local Estonian aspects. The most common (ca 300) species are provided with detailed descriptions, color photos and voices. "Estonian Vertebrates" has been developed in order to be applicable in biology classes both in basic and secondary school. Therefore the information about each species has been presented on two Web pages considering students' different age and abilities. The first page gives general information about particular species including its appearance, distribution, abundance, feeding, reproduction, development and endangerment. This one is mainly orientated to the basic school students. Considering this, the first page has fewer scientific facts and simpler vocabulary whereas the second one - supplementary information page - has some more terms and scientific information. This additional material is mainly assigned to the secondary school students (Adojaan & Sarapuu, 1997).

The principles of composition of "Arthropods" Web site (*http://www.zbi.ee/satikad/*) are completely different. It gives a systematic survey of all the classes and orders of Arthropods. It is composed as an attractive supplementary reading material to encourage students to study Estonian nature. Different groups of Arthropods are characterized by their morphology, anatomy and physiology (e.g. reproduction, development, feeding, adaptations, etc.). An essential part of each topic is the information about the behavior and adaptation of Arthropods. The data of their ecology are concerned with interactions with environment, plants and other animals. "Arthropods" Web pages are illustrated with original colour photos, schemes and drawings. The presented material is not so directly meant for the basic or secondary school students, but for everybody interested in the life of Arthropods and generally in Estonian nature.

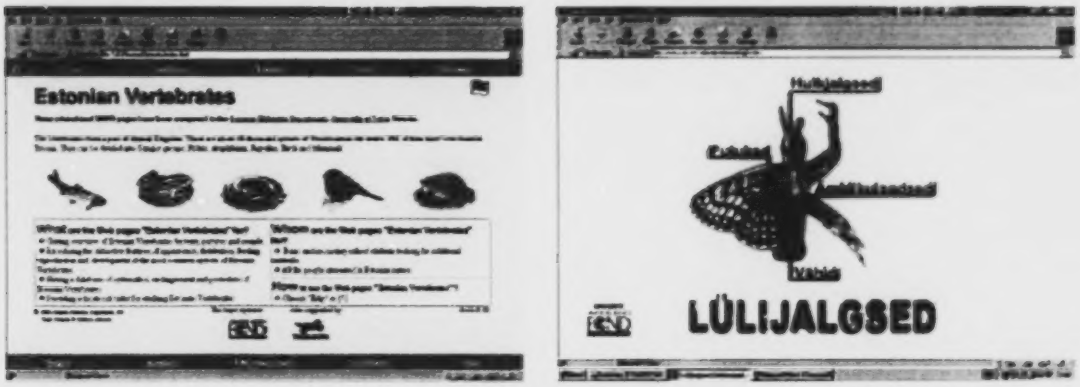

Fig. 1. The front pages of "Estonian Vertebrates" (on the left) and "Arthropods" (on the right) Web sites.

An Expert Group

An expert group consisting of 27 biology teachers had previously passed an advanced in-service course in usage of computers in school biology. Teachers came from different regions of Estonia and had some previous experience in the application of computers in teaching biology in basic or secondary school.

At first, an introductory lecture about the concepts of evaluation of educational software and instructional Web sites was conducted to the teachers. Subsequently, they had the opportunity to get acquainted with two Web sites - "Estonian Vertebrates" and "Arthropods". At the same time they participated in the evaluation process based on the Scale described in the previous section.

Results

27 biology teachers evaluated "Estonian Vertebrates" Web site and 22 of those ranked the proposed aspects of "Arthropods". The first unit of the first part of the Evaluation Scale was concerned with general characteristics. The average ranks calculated from the teachers' opinions (Fig. 2) revealed that the target audience and the objective of "Estonian Vertebrates" Web site are more clearly presented (questions 2 and 3, respectively). This result is closely related to the question number 11 of the second unit - "the front page is reasonable and comprehensible" (Fig. 3). The front page of "Estonian Vertebrates" is more informative, than the first page of "Arthropods" which appears to be more illustrative than informative. Teachers also thought that the navigation devices on "Estonian Vertebrates" Web site were more convenient (question 8).

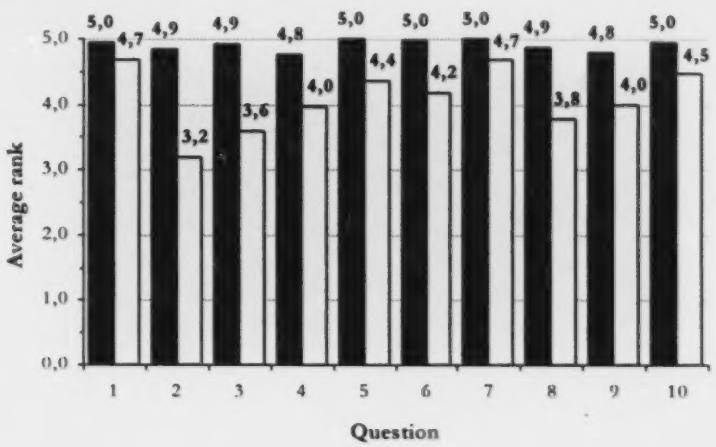

Fig. 2. The average ranks of the general characteristics of "Estonian Vertebrates" (+) and "Arthropods" ( ) Web sites.

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The second unit was concerned with the presentation and illustration of information (Fig. 3). One of the greatest advantages of "Estonian Vertebrates" Web site is that it is provided with real voices of nature - several species are characterized not only with text but also with their voices (question 18). As far as birds are concerned, their song is an essential feature in recognizing them in nature. Neither "Estonian Vertebrates" nor "Arthropods" Web site includes video and animation. Therefore, some questions of this unit are not applicable with these Web sites.

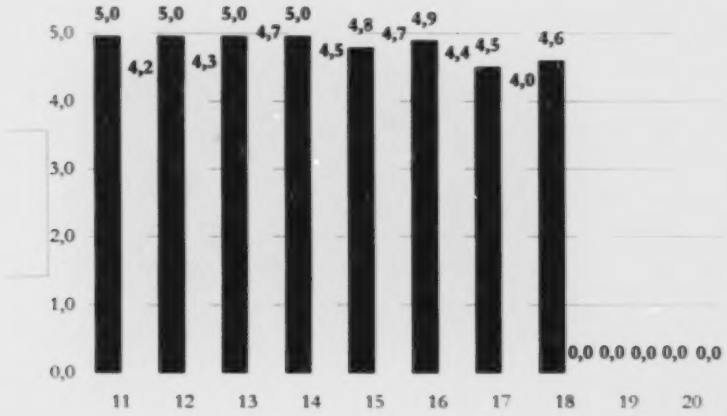

Fig. 3. The average ranks of the presentation and illustration of information on "Estonian Vertebrates" (+) and "Arthropods" ( ) Web sites.

The third unit asked for the user's impressions. Teachers valued "Estonian Vertebrates" Web site higher in all the aspects (Fig. 4). This result proves that "Estonian Vertebrates" Web pages are more attractive and enjoyable. Considering this it is suggested that the material presented on "Estonian Vertebrates" Web site enhances the learner's motivation and interest in school biology.

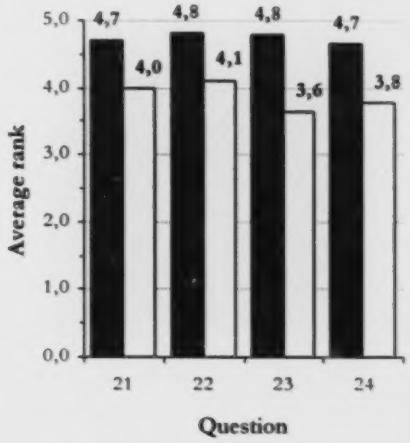

Fig. 4. The average ranks of the user's impression concerning "Estonian Vertebrates" (+) and "Arthropods" ( ) Web sites.

The second part of the present Evaluation Scale studied pedagogical aspects of two Web sites. There were no essential differences in the teachers' opinions (Fig. 5). The "Estonian Vertebrates" was thought to be more gener-

ally focused compared with the orientation of "Arthropods" Web site (question 26). The teachers' answers also revealed that "Arthropods" provides more possibilities for feedback (question 29).

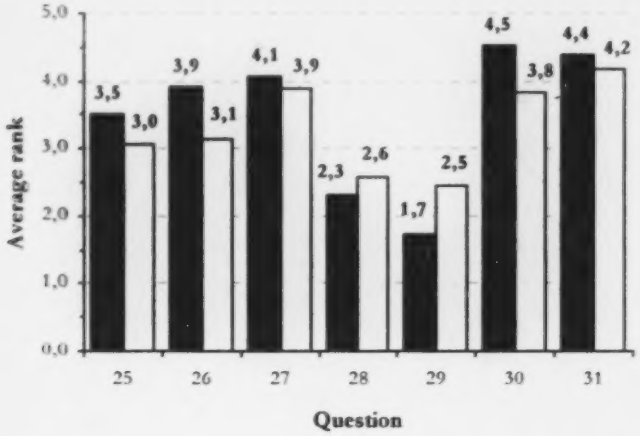

Fig. 5. The average ranks of the pedagogical aspects on "Estonian Vertebrates" (+) and "Arthropods" ( ) Web sites.

The last part of the Evaluation Scale rated the curriculum-related aspects (Fig. 6). Both sites are applicable in teaching various themes of curriculum (questions 32, 33), but also in extra-curriculum activities (34). The main difference between "Estonian Vertebrates" and "Arthropods" Web sites is in their vocabulary. There are more incomprehensible terms in the topics of "Arthropods" (40). The scientific terms are well explained in the texts of "Estonian Vertebrates" (41) and therefore the presented material is better comprehensible by the basic school students (36). The successful application of "Arthropods" Web site depends on supplementary materials (42).

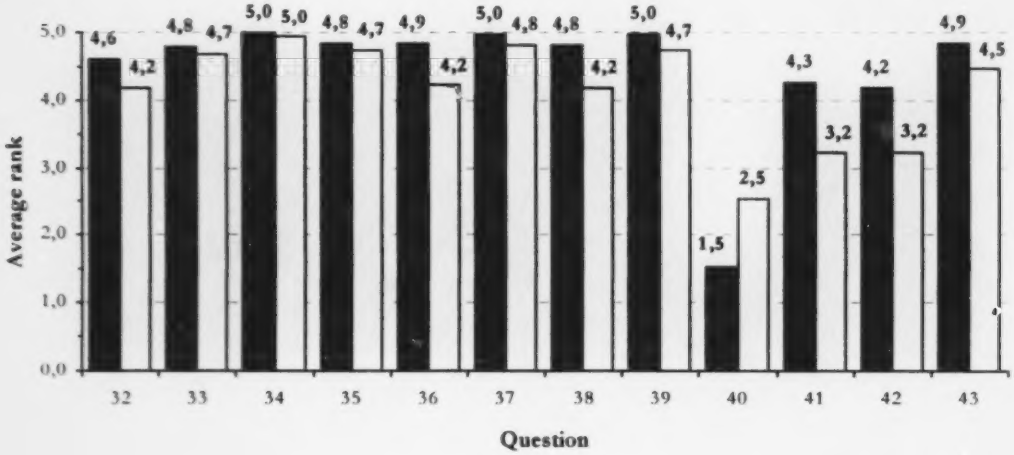

Fig. 6. The average ranks of the curriculum-related aspects on "Estonian Vertebrates" (+) and "Arthropods" ( ) Web sites.

Several criteria for evaluating the educational Web sites have been chosen as a result of the present work. Consequently a special Evaluation Scale consisting of 43 questions has been worked out. The Evaluation Scale

considers several curriculum-related aspects. This is the main difference of the proposed scale compared with the others. It is supposed that present Evaluation Scale is not only applicable with educational Web sites connected with Estonian State Curriculum but also with various instructional Web sites of different countries.

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An Author-friendly Concept for Multi-User Virtual Environments in VRML

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Abstract: This paper describes a concept for Multi User Virtual Environments based on VRML and Java. Special emphasis is put on the ease of use for the world author who wants to make his or her worlds multi-user capable. Apart from being easy to apply, the concept introduced here was designed to be simple and platform-independent.

1 Introduction

One of the visions often associated with the *Virtual Reality Modeling Language (VRML)* [VRML97] is that of a giant networked 3-dimensional "cyberspace" in which people can meet and interact. Yet, despite the astonishingly rapid development of VRML, which has recently become ISO standard, so far multi-user interaction in VRML-based virtual environments has not become commonplace. In this paper we want to put emphasis on a very important aspect in multi user systems: Distributed applications are inherently more complex than usual, single user applications. This complexity is often passed on to the scene author. The *Multi User System Concept (MUSyC)* introduced in this paper is a new approach towards providing simple, portable, and efficient multi-user interaction in VRML. Our prototype builds entirely upon the VRML 97 standard with no proprietary extensions, is written in Java for platform independence, and has been designed specifically with the world author, who is usually not a distributed systems expert, in mind. In the following, we will present the concept and how it uses certain features of VRML. Finally, the authoring process of a shared world is discussed.

2 System Architecture

Most of the well known approaches to implement distributed multi-user virtual environments (distributed VEs) like DIVE [Carlsson 93], [Hagsand 96], [Hagsand 97], NPSNET/DIS [Macedonia 94], [Macedonia 95a], [Macedonia 95b], Community Place [Lea 97] or the Living Worlds proposal [Honda 97] use an object-oriented paradigm to model shared scenes or shared worlds. VRML, however, is based upon the concept of a scene graph composed of nodes, rather than on an object model.

MUSyC takes the VRML concept into account, and does not try to superimpose an object model on the scene graph model. Changes in a VRML scene occur when the state of nodes within the scene graph changes. Such changes are caused by the reception of events via "route" connections between nodes. MUSyC controls the generation of events by replacing the Nodes which are capable to start so called *event cascades* with special shared nodes.

The new MUSyC specific *sharedArea* node handles all the communication over the network including the communication necessary for controlling the user's Avatar. An Avatar is basically a VRML Transform node extended by an additional field containing an identification.

There are two major networking tasks to be performed by the MUSyC System: the coordination and distribution of events generated by sensors and scripts, and the distribution of Avatar position data.

2.1 Authoring of Shared Worlds

An important aspect in the design of a multi user virtual environment system is the support for world authoring. As stated earlier, distributed systems can be very complex. An important goal in the design of MUSyC was to hide this complexity from the world author when possible, while maintaining a maximum of flexibility. Therefore MUSyC allows the easy adoption of standard VRML 97 scenes to the new system. There are only three simple tasks to perform to turn a VRML world into a MUSyC enabled world:

1. Sensor nodes in the VRML file have to be replaced with their shared counterparts. Unique identifier strings for each must be provided.
2. Java programs that implement VRML Script code must be modified to inherit from shScript instead of Script.
3. A MUSyServer must be set up. For large worlds designed for large numbers of participants, a map describing all sub-areas with their assigned multicast groups must be created.

In contrast to other systems, the world author does not need to identify events that need to be shared among worlds and specifically integrate shared nodes and set up routes in the world. Modifying a moderately complex scene for sharing thus often becomes a matter of minutes.

The more familiar an author is with distributed multi user issues, the more complex worlds he may create using MUSyC. It is easy to develop shared applications for the MUSyC system, since all a developer has to do is either use the shared script features or adhere to the very simple Avatar interface. In both cases the developer can use whatever network capabilities he requires and implement any concept he wishes.

Thus MUSyC is both easy to use for world authors and easily extensible for application developers.

3 Conclusion

In this paper we have presented a multi user system concept for VRML that builds upon the core concepts of the language in order to ensure simplicity, efficiency, and scalability. Even though the system allows sharing of complex interactive virtual environments, it is not difficult to implement for authors.

Future work may include a framework for customizable Avatars that supports the author with means for direct communication (behavior) between Avatars.

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Online Art History:
Design, Development, and Review of an Interactive Course

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Abstract: Carnegie Mellon Online has been used to deliver several university courses to thousands of students at Carnegie Mellon University over the last two years. This paper describes the experiences gained from redesigning an introductory art history course using Carnegie Mellon Online to deliver supplemental course content. The technology, course content, and structure, assessment tools, and course management capabilities are discussed, as well as lessons learned from creating this course, and plans for the next version.

This paper describes the experiences gained from redesigning an introductory art history course using Carnegie Mellon Online to deliver supplemental course content. Carnegie Mellon Online is a database driven, web-based educational tool that has been used to deliver several university courses to thousands of students at Carnegie Mellon University. The technology, course content, and structure, assessment tools, and course management capabilities are discussed, as well as lessons learned from creating this course, and plans for the next version. Descriptions of Carnegie Mellon Online courses are available at `http://online.web.cmu.edu/`.

The Technology: Carnegie Mellon Online

Carnegie Mellon Online is a unique, database driven, educational tool taking advantage of the World Wide Web to provide student-centered instruction. The system generates customized content, such as assessments and feedback for each student and tracks the student through a course while maintaining course-specific rules and policies. Using this system, the instructor sets guidelines and prerequisites for student advancement through the course material, allowing the progress of each student to be individualized and paced for his or her learning style. It also provides students with more control over their learning experience by permitting them to access their class at any time they choose and as often as they choose, as best suits their needs.

Carnegie Mellon Online is not limited to a specific discipline or type of course. Courses in all university disciplines can make use of its unique, student-centered approach to education in a variety of ways. It can be used to offer completely online courses that never meet in a classroom, can act as an online management and learning tool to complement classroom-based courses, or it can act solely as an assessment tool.

One of Carnegie Mellon Online's strengths is it's ability to handle assessments. Like the rest of the system, assessments are data-driven; a standard set of code generates individualized assessment descriptions, generates the HTML forms, delivers the assessments, accepts the assessments, automatically grades certain types of assessments, and delivers feedback to the students.

Security is always a concern when delivering classes via the web. A student must use a password to access any course learning material, assessments, or feedback. Students use their university password to access Carnegie Mellon Online. This same password is used to access their email, grades, course registration

sites, etc., which reduces the likelihood that students will share their passwords with other students to cheat on their course work.

The Course: Pre-Industrial Visual Cultures; to 1789

Pre-Industrial Visual Cultures; to 1789 (PVC) is the first course in a three-semester sequence of courses required of majors in the School of Art at Carnegie Mellon University. It is geographically and chronologically the most broad of the three courses, introducing students to the ideas and artifacts of world cultures from Paleolithic cave paintings to the French Revolution and including Africa, India, China, Japan and the Ancient Americas.

The structure of the course is twice-a-week lectures and once-a-week discussion sessions. Lectures focus on works of art in their cultural context. For example, a lecture on the art of India investigates how visual expressions reflect historical background, politics, geography, social structure, religious beliefs, and the role of the artist in India. One class per week focuses on synthesis topics, such as mythology, the role of the artist, and patronage, which explore thematic comparisons across cultures. In these sessions, students are assigned to work in small groups to brainstorm ideas, discuss issues and make summary presentations. For example, when we discussed archaeology as a topic, each student group developed a set of questions that an archaeologist would ask about an artifact and made conclusions about the artifact that they were given. The assignment for the topic required that students discuss what an archaeologist in the future would say about our culture from unearthing a shopping mall or a gallery showing their own artwork.

Since the Spring of 1995, Carnegie Mellon art historian Mary Schmidt has taught this course by projecting images and text in the classroom with a custom-designed, infinitely modifiable digital image database. She has also developed a text-based web syllabus with course overview, calendar, readings, links to relevant websites, and essay assignments.

PVC Online

In the Summer of 1997, Schmidt, Rehak, Blackmon, Bajzek, and a team of others collaborated to turn the classroom teaching tools and web syllabus into comprehensive web-based learning tools via Carnegie Mellon Online. The result was the delivery of a database driven, interactive website that contains all of the materials supplementary to the classroom experience – except for the required text book and visits to the museum. The site contains a course overview, calendar, images, timelines, maps, reading assignments, and links to other websites. It quizzes students on their reading assignment before each class period and accepts their weekly, electronically submitted essays. On a daily basis, it gives them their personal status in the course with regard to upcoming and/or overdue assignments and their cumulative grade. When students login, it opens to the current topic for the day.

The first iteration for Spring 1998 exceeded some aspects of our original concept and fell short on some others. The assessment component proved to be a powerful tool. Students developed the sound practice of keeping up with the readings, and they improved their test taking abilities over the semester. They were prepared for class! No weekly essays for this class of 55 students were lost. No *my-dog-ate-it* excuses. Admittedly there were computer glitches; many students required extra help to set up their web browsers to upload their written assignments.

We planned a searchable database of images but due to time constraints, settled for a sample of linear sequence images for each culture topic. Likewise, we planned a glossary but temporarily postponed its development. Both components are priorities for the second iteration for Spring 1999.

Structure of the Online Course

Content

The PVC Online interface structure gives students access to guideline information about the course and to their status with regard to grades and assignments as well as comprehensive materials for each day's topic.

Global Content

Instructor information lists when and where the course meets, and gives the instructor's phone number, email address and office location. A course description outlines course goals, policies, and procedures and instructs students how to navigate the site. A calendar and a topics list display the schedule for the semester in two different formats. A status chart gives students individualized reports of the entire semester's quizzes and assignments – what has been completed and when each was submitted, what's late, what's due next, and what the cumulative score to date is (Figure 1). Another page lets each student know what's next, what is overdue and what the deadline is for each overdue item.

Culture Content

For each culture topic there is a brief introduction to the topic, reading assignments, map, timeline, images, links to other websites, and a quiz. Students may also, at any time, access global information for the entire semester. For example, students may toggle between the global map and local map; likewise between the timeline for the semester and the culture timeline, and they may read semester guidelines for quizzes, reading assignments, and links to other relevant websites. Images are selected examples for which the instructor holds the copyright. As already discussed above, four randomly generated questions comprise the quiz to be completed before class begins.

Synthesis Content

For each synthesis session there are a brief introduction to the discussion topic for the day, a reading assignment, and a description of the written assignment to be electronically submitted the following week. At the end of the assignment description are instructions for submitting an assignment electronically.

Interface

Students navigate the PVC Online website through clickable buttons. The interface is designed with buttons across the top for administrative information and left/right navigation backwards and forwards through the semester's topics (Figure 2). When students log in to the course, the first page that is presented is for the cultural or synthesis topic that will be discussed at the next class meeting. In the left column are bi-colored buttons for course content materials. All of the information that students call up through navigation of the site appear in the central frame of the window. Only links to other websites call up new windows. Details follow.

Header Row.

Buttons in the upper left of the header include Course Description, Mary Schmidt (for who, what, when, and where information), Calendar and Topics List. In the upper right are Your Status, Do/Due Now, Today and Logout. The upper center frame indicates the current topic title with left and right arrows to move forward or backward through the topics for the semester.

Left Column.

There are two sets of bi-colored buttons, one each for culture and synthesis topics. Culture buttons include Home, Readings, URLs, Maps, Timelines and Quizzes. The light blue left side brings up semester-wide information; the dark blue right side, information specific to each day's topic.

Assessments

Because of Carnegie Mellon Online's assessment capabilities, we decided to encourage students to be prepared for class by requiring them to take a short quiz based on the text before attending class. Like paper- based quizzes, the instructor had to decide what kind of quiz was appropriate for testing the students' comprehension; she chose to use a four question, multiple-choice quiz.

For paper-based quizzes, the instructor would simply write four questions per topic and photocopy the quiz for each student.

However, since the Online technology can generate individualized, randomly generated quizzes for each student, the instructor divided each quiz into four topics and created three multiple-choice questions for each topic. For each student, the system chose one question from each of the four topics, randomly permuted the answers, and generated the HTML form for the quiz.

In addition to creating the quiz content, the instructor had to determine the policy for the quizzes, such as:

- when can a student start a quiz? when is the last time that a student can start a quiz? turn it in?
- when is a quiz due? what is the penalty for turning it in late?
- can a student choose to retake a quiz? how many times? is it the same quiz or another randomly generated quiz? what is the penalty?
- can a student see any of the course's online learning material during a quiz?
- what feedback does the student get?

In order to show the flexibility of Carnegie Mellon Online, the instructor's policy decisions and rationale are presented.

A quiz is due thirty minutes before the class meeting and may be started up to a week before the class. This discourages students from finishing a quiz just as the class starts. Late quizzes are penalized 25%, which is the equivalent of missing one question. A quiz may be taken up to two weeks after the class, which prevents students from waiting until the end of the semester to do all the quizzes.

Students who do poorly on a quiz can elect to take a second randomly generated quiz, which carries a 25% penalty. Students are allowed to see all of the course's online material during a quiz.

After submitting a quiz, a student is not shown the correct answers or even the questions. The student is only told how many questions were answered correctly. This policy discourages students from compiling printouts of questions and answers and sharing them with current or future students. The instructor however has access to the individual questions and the student's answers for each quiz. Students may discuss individual quiz results privately with the instructor, but have not expressed much need to exercise this option.

The instructor realizes that these policies do not prevent students from working together on quizzes. However, the security system discourages students from giving their password to one student to take quizzes for the group, and the individualized quizzes make it harder for students to copy other students answers. We believe that these measures bring about the intended goal of these quizzes – to encourage students to read, think, and talk about the material before coming to class, whether they take the quizzes individually or in groups.

Policy for Written Assignments

Students are also required to submit one written assignment per week; this is done as a file upload through the course's web interface. As with the quizzes, the instructor had to determine the policy for these written assessments.

Written assignments are due on a day when the class does not meet. Late assignments are penalized 25%. The assignment submission page is available from 30 minutes after the class in which the assignment is

discussed until two weeks after the due date. This prevents students from submitting all assignments at the end of the semester. However at any point during the semester, the student may see the instructions for the assignment.

Papers may not be rewritten and resubmitted. The system only allows a student to submit a single paper. Students are allowed to see all of the course's online material while working on an assignment.

After a student submits an assignment, an acknowledgment is given that the paper has been accepted.

Students receive written feedback on their papers from the instructor. The instructor's interface is described below.

Management Tools

Through a separate administrative interface, the instructor has electronic access to statistical information about quizzes, to individual student's status reports, to grade summaries for the entire class, and to screens which allow changes and corrections to accommodate idiosyncrasies – student illness, adding and dropping the class, re-writing essays.

For the first time, the instructor is able to do something she has always wanted to do, but didn't have the time to do: compile a statistical analysis of students' answers to quiz questions. The quiz summary displays in graphic format how many students scored 4 out of 4, 3 out of 4 and so forth; and displays how many right and wrong answers there are for each question. It gives her the opportunity to assess the clarity and fairness of questions as well as students' understanding of the material.

Since Carnegie Mellon Online compiles and reports each student's cumulative numerical score and percentage, reporting mid-semester and final grades for 55 students is much less labor intensive than in the past.

The instructor can change an individual student's deadline for quizzes and assignments in case of illness, can change a quiz score after a well-argued rationale for a wrong answer, can change a grade for a re-written essay, and can add or delete students on the class roster.

Lessons Learned and Future Plans

Rethinking assessments.

Much of the time spent in moving the course to the Carnegie Mellon Online was spent in rethinking assessment tools. In previous years, the instructor would use less frequent tests based upon both the lectures and readings. With the new automated system, the instructor chose to use quizzes before class meetings to promote reading. But this brought a new problem. Test questions from lectures and readings which address issues of comparison across time and cultures are missing. The next iteration of the course will include monitored web-delivered mid-semester and final tests.

Student Reaction

Spring 1998 students are excited to be a part of this project. They showed we're-all-in-this- together enthusiasm, exhibiting patience when there are computer glitches, studying together, and discussing art history. Other faculty who teach the same students relate that students think it is great to have "all this stuff" available to them. Though these students have been thoroughly assessed through twice-a-week quizzes and weekly essays, there have been no complaints about the work load.

A Priori Content

In this first version of Carnegie Mellon Online, all content had to be entered before the beginning of the semester. This placed a large burden on the instructor to plan the course content, assessments, and policy well before the semester started. For this art history course, the course interface and policy were set about six

months before the semester; the majority of the content and assessment questions were in place about four weeks before the semester, with the remainder of the time spent refining the content and testing the system.

On the other hand, the benefit of this requirement is that the instructor is now free to spend more time with the students and planning individual lectures. Furthermore, this allows students to see the content for the entire semester at any time during the course. It also prevents students from having an inconsistent experience with the course – namely the threat of a student seeing material, and then having it be changed by the instructor without the student's knowledge, and the student not seeing the new material.

Though the benefit outweighs the burden, many instructors may not want to commit so much planning time before a class and may not have the time to prepare the entire content before the class starts. The next version of Carnegie Mellon Online will allow an instructor to add and update the course's content during the semester.

Future Plans.

The next version of this course will have several enhancements including a glossary, assign ments based upon the web materials, and web-delivered mid-term and final exams with new kinds of test items in addition to multiple choice questions, such as matching, short answer, and image identification items.

The most important addition will be an image database to replace the current linear sequence of sample images. Schmidt has over 2,000 digital images of artifacts relevant to this course. We will create an interface that will allow students to search the database based on several descriptors of the artifacts, including artist, location, period, style, theme, and type of image. The students will then have instant access to the found images. One of the exciting aspects of this database is that the term "image" is not limited to a single static image; instead, it includes any of the media that can be delivered over the web including movies, three-dimensional models, and virtual reality models.

Conclusion

For all of the participants in this project, the journey has been an intensive collaboration to integrate pedagogy and technology for the creation of a comprehensive and effective online teaching and learning tool. We are enthusiastic about the results and are planning improvements for the future.

Acknowledgments

The Carnegie Mellon Online project is funded by Carnegie Mellon University.

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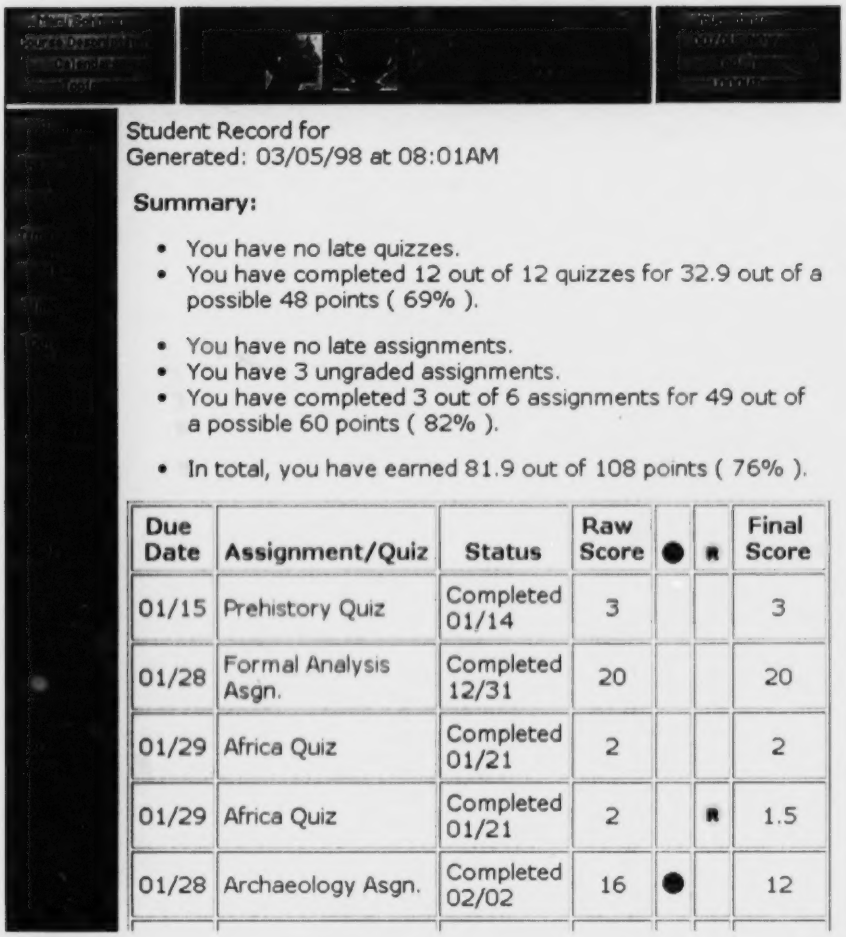

Student Record for
Generated: 03/05/98 at 08:01AM

Summary:

- You have no late quizzes.
- You have completed 12 out of 12 quizzes for 32.9 out of a possible 48 points (69%).
- You have no late assignments.
- You have 3 ungraded assignments.
- You have completed 3 out of 6 assignments for 49 out of a possible 60 points (82%).
- In total, you have earned 81.9 out of 108 points (76%).

Due Date	Assignment/Quiz	Status	Raw Score	●	R	Final Score
01/15	Prehistory Quiz	Completed 01/14	3			3
01/28	Formal Analysis Asgn.	Completed 12/31	20			20
01/29	Africa Quiz	Completed 01/21	2			2
01/29	Africa Quiz	Completed 01/21	2		R	1.5
01/28	Archaeology Asgn.	Completed 02/02	16	●		12

Figure 1: A Sample Status Page for a Student, Showing Aggregate Performance As Well As Individual Grades.

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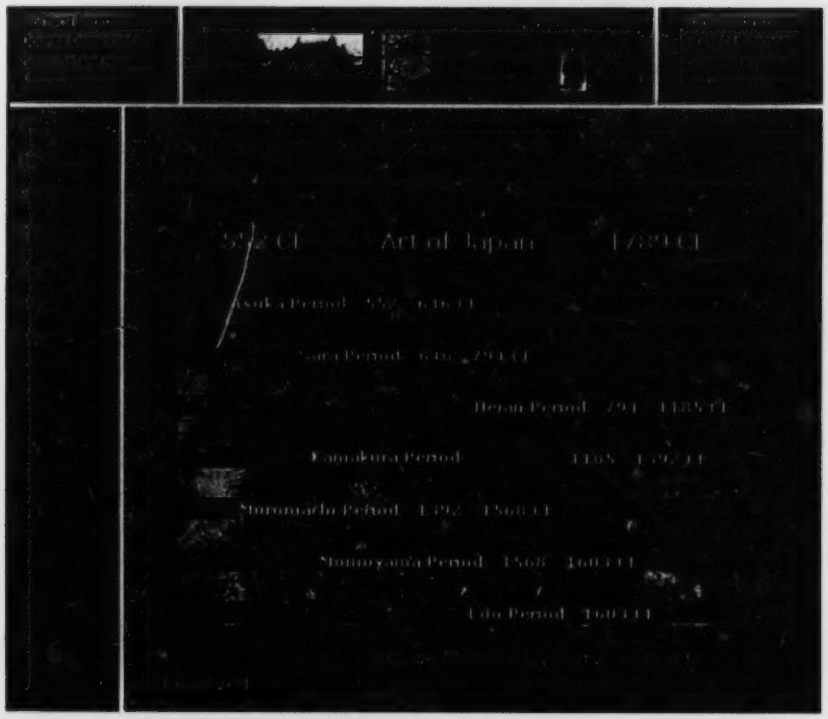

Figure 2: The Timeline for the Japanese Cultural Unit.

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Advising Functions for Regional Online Tourism Information Systems

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Abstract: Studies indicate that travel sites are amongst the most visited sites on the internet. Additionally, visitors of a town or region mostly wish to spend their (limited) free time as pleasant as possible. At the Bavarian Research Center for Knowledge-based Systems (FORWISS) the concept of an application is developed which supports tourists to plan their stay regarding their time restrictions. It is intended to design a program which enables web-surfers to access an information base providing them with an individual approach to their search. According to different previous experiences the system assists users with distinct tools.

1 Introduction

For cities, tourism is a source of income which influences not only hotels, restaurants, museums, theatres, etc. but also city traffic and retail. Therefore, town councils and organizers are investing in advertisement and events to attract travelers. Destination information systems can support these tasks. They enhance the interest of travelers in a region. These applications assist tourists in planning their stay by helping them to choose accommodation, food, sightseeing, and things to do. The factors confidence and experience are relevant aspects. This is a special characteristic of tourism information systems.

2 Assisting Tourists Planning their Stay

The article sketches some possibilities how a destination information system can support tourists. The described functions are developed for a system based on the Internet which contains information about Nuremberg (Bavaria, Germany). The tools are divided into three classes: instruments, automatic mechanisms, and agents.

2.1 Instruments for Information

Instruments which support the information demand process can be search functions, calendars of events, and interactive city maps.

A calendar of events provides current schedules, e. g. of theatre and cinema performances. Looking for subjects, locations, times, and keywords is possible. Searching with keywords can be interesting, for instance, if someone wants to get informed about concerts of a certain musician. Then he/she only has to enter the name of the artist, and the system subsequently lists every offer containing this name.

To facilitate the orientation within the region, a system of maps is available. There is one general map to survey the surroundings and look for travel infrastructure like highways, railroads, and airports. The next level provides city maps for every town in the region. The city maps offer a search function. So tourists are able to look for a location, such as the museum of traffic. On the map, the place will be marked. The system includes specific site maps for some famous and big buildings like the castle.

Both instruments (calendar of events and interactive city maps) are supported by search functions. Looking for information users can choose an item from defined lists, which are divided into different categories, or enter a search text. For people who are unfamiliar with the region it is easier to select items from the lists. A free query where tourists enter a search expression creates more possibilities but is only reasonable for persons with previous experience. To improve this functionality queries by keywords are supported. For example, if a visitor wants to get information about a famous person of the city, he/she only inputs the keyword and the system presents all places referring to this keyword, i. e. photos, geographical positions in the city maps, opening hours, entrance fees, etc.

2.2 Automatic Mechanisms

Some automatic mechanisms can support tourists to plan their spare time. Such tools can be proposals for defined situations, a time table and individually generated spare time programs.

In conventional Internet search engines some topics are queried more often than others. Therefore, dedicated web pages are built for these subjects that users can take a direct look to the results without searching. Likewise, some situations are typical for users of tourism information systems. For these problems, we combined different activities designed for the respective target group and present them on separate pages. There are, e.g., suggestions for tourist stays adapted to the amount of time tourists are planning for their visit as well as proposals for company excursions, school trips, rainy sunday afternoons, romantic hours, etc.

In order to design their spare time, users can be supplied with an electronic diary. They only need to enter their dates of free time. A traveler, for example, inputs that he/she would like to spend his/her leisure time from the 1st to the 3rd of January in the region. In turn, the system creates an empty calendar which considers the entered date restrictions. The visitor clicks on a certain time, maybe the evening of the 2nd of January. He/she then receives ideas how to spend this evening.
The calendar can be filled with selected actions. To pick out activities, the visitor has to choose categories which interest him/her. According to the marked topics, the system lists all activities found in the calendar of events or in the database of leisure activities. Only these offers are shown that take place at the chosen time. The visitor selects the preferred activity for the evening of the 2nd of January. In this way, the visitor can fill all time slots. The result is an individual calendar containing different activities.

The system is also able to create individual spare time programs oriented towards the special interests of users. Therefore, the visitors input some data by which the system can perceive their interests. For the realization, the concept of stereotypes is used. This means, if some facts (called the triggers) are known, a bundle of characteristics can be assumed. In destination information systems the characteristics are the users' interests. To consider individual time slices, tourists can enter days and times (i. e. morning, afternoon, and evening) for getting suggestions.
Using few input data the destination information system presents its proposals for spending the time. But as everybody is different, non-typical users have the possibility to change their profiles. After the presentations they can either accept or decline the proposals. If visitors are dissatisfied they have the chance to check the generated profiles. There they can see which areas have been designated as being interesting for them. They may modify the profiles and then the system would create new schedules based on the changed profiles.

2.3 Agents

Different kinds of agents are conceivable to assist travelers. Two possibilities are described as examples: personalized emails and electronic leaflets.
Sending emails that consist of general content for every user who wants to be informed about news has the drawback that receivers may experience information overload and will not read the emails. Therefore, they will not get the information referring to their interests. An idea of one-to-one marketing are personalized emails. If people are interested in special events, for instance classical concerts, they can request that they wish to receive emails with information every time a new classical concert is entered into the system.

People who are interested in certain activities but are not able to attend them within the limits of actual free time can mark these objects. The system generates an electronic leaflet for every user. Next time the users wish to undertake something, they first take a look into their leaflet. In case the leaflet contains activities limited in time, the users will receive an reminding email before the event..

3. Capitalizing on the Opportunities of Destination Information Systems

The tool is interesting for tourists as well as for citizens living in a region. Because of its functions a user visits the pages not only once but many times, maybe even regularly. Thereby the number of accesses to the web site as well as to linked applications will increase. Places for advertising banners can be sold for better prices the more users frequent a site.
Lists of hotels and restaurants can be integrated into the system. Some objects of these lists can be considered in the individually generated spare time programs. For these references, the hotels and restaurants have to pay a fee.

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Integrating a Web and Live Symposium - the Learning.Org Experience

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Abstract: In September 1997 the KMi Stadium telepresence architecture was used to implement a webcast in support of a physical symposium meeting called 'Learning.Org', which took place some 3 weeks later. In this paper we describe the webcast and discuss how it supported the physical meeting. Overall, the event was a great success and we argue that it provides an interesting model for the virtual support of real symposia.

Introduction

Large scale physical meetings are an essential part of information flow in many organisations, and yet the ineffectiveness of large meetings is widely accepted. Most large meetings are set around a format of bringing people together over long distances, and at great expense, to sit passively through slideshows and carefully choreographed panel discussions. The delegates come to such meetings because they recognise the importance of putting names to faces and thence to ideas. However, they also recognise the supreme importance of talking to presenters and other delegates about these ideas and the constraints that the typical auditorium format places upon this. Usually, delegates seek to make up for these constraints by "networking" in the gaps - over coffee, a meal or even through a chance meeting in the corridor! We believe that physical meetings are indeed very important to the social context of learning, however we argue that even if one does not wish to completely replace a physical meeting with a virtual one - one should explore the use of technology and social context in a virtual meeting to make the physical interaction much more effective. Most webcast projects focus on replacing physical meetings with virtual ones. In the Knowledge Media Institute Stadium project we have explored a wide range of different models, including the replacement of the real with the virtual (http://kmi.open.ac.uk/stadium/). However, in the work discussed in this paper we aimed to use a virtual event as part of a range of resources to enhance a physical event. By adding value to a physical meeting experience in this way we argue that it is possible to radically change it, such that the nature of this type of symposium can be radically improved in a networked world.

The Design of the Learning.Org Event

Late in 1997, the stadium architecture (http://kmi.open.ac.uk/stadium/) was used in support of a symposium arranged by an organisation styling itself *learning.org* (*not* an internet domain name - but a vision of a university as a learning organisation). The meeting was designed as a forum for senior university management staff (at pro-Vice Chancellor level in the UK) with particular responsibility for the overall strategic direction of the use of information technology within their university. Its aim was to invite these managers to meet and share best practice and experience on the introduction of new technologies into teaching and learning in the UK. A physical meeting was scheduled for the 26th of September 1997. However, to make the physical meeting more productive, a number of resources were designed by the KMi Stadium team (http://kmi.open.ac.uk/learning.org/). The site included a registration interface for secure access, an area for the management of participant self-statements, pointers to other useful sites and interactions, and a web forum. At the centre of these resources was a live webcast on the 4th September 1997 at which the slide presentations were broadcast and discussed. By the time that these managers physically shook hands, they had started to think through the important issues with people they had already virtually met both synchronously and asynchronously. They were also able to move very quickly past presentation to discussion and interaction. In

figure 1 we see a screenshot of the Learning.Org site. The Learning.Org website was opened in August 1997 to registered delegates only, but it is now open to public viewing.
The symposium was effectively a 5 stage event: delegate registration and disclosure; the Webcast; a pre-meeting digital document discourse; the physical meeting itself; and the post symposium site.

Figure 1: The Learning.Org website.

Stage 1 - Registration. The site shown in figure 1 had a very simple registration interface - most users registered directly with the Learning.Org office where they received a username/password key to the site. This gave them access to all of the site resources and allowed them to post a statement about themselves and the issues that they wanted to see the symposium cover.
Stage 2 - The Live Webcast. The live webcast event consisted of three 15 minute talks interspersed with roundtable question and answer sessions broadcast into the internet from the Open University in Milton Keynes. The event was made available after the live session as a near-instant replay (the audio was cleaned, and re-encoded for bandwidth negotiation). The Webcast stage is discussed in more detail below.
Stage 3 - A Digital Document Discourse. The web forum was opened immediately after the webcast (see Sumner and Buckingham Shum 1997, http://kmi.open.ac.uk/techreports/papers/kmi-tr-50.pdf).
The forum was based upon the presentations given in the webcast plus some ancillary documents. These were processed by the Digital Document Discourse Environment (D3E, http://d3e.open.ac.uk/). The D3E toolkit processes documents and presents them in a web version that integrates the publication with a live asynchrounous threaded discussion. In this way the delegates were able to continue the discussion which was initiated by the webcast right through to the physical meeting and beyond.
Stage 4 - The Meeting. The physical meeting was held in Milton Keynes on 26th of September 1997. After a short recap of the presentation and subsequent discussion which was to frame the day, the delegates broke into small groups for detailed debate about the issues of framing information technology strategies for UK universities.
Stage 5 - The Post Symposium Site. After the symposium, all of the event assets on the site were opened to the public and the recommendations of the meeting and delegates notes were used to form extra pages in the discussion. A policy paper recommending ways forward from the symposium was created by participants and is on the site.

The Learning.Org Webcast

The webcast was implemented using the KMi Stadium architecture. The Stadium project covers a range of experiments and prototypes in web telepresence from the pure Java Inferno toolkit

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(http://kmi.open.ac.uk/stadium/inferno/), through to the latest two-way full-voice Lyceum prototype (http://kmi.open.ac.uk/stadium/lyceum/). Many of the telepresence experiments we have conducted have used non-Java versions which have been implemented directly in the Browser using a mix of JavaScript, html and cgi tools. The Learning.Org webcast was implemented using the latter non-Java browser-based system with RealNetworks™ streaming (one-way) audio.

The Webcast Setup

A practice webcast interface was provided to delegates, to enable them to test the ability of their set-up to participate in the webcast. The practice example has been removed from the replay (which is its own test). The interface itself uses JavaScript to test for the basic browser and plug-in combinations, and wont let you proceed until you have an appropriate combination. Users who fail this are directed to a local copy of the appropriate software (in this case Netscape Navigator 3.01+ and Real Networks RealPlayer 4.01+). However, the practice interface was vital to allow users to test for the acceptable performance of their machine and network under sensible test-broadcast conditions. For example, some of our users inhabited networks which lie behind firewalls that bar the RealNetwork™ stream we were using to carry the audio. A voice and email hotline was provided to registered delegates to assist with debugging problems of this sort. The vast majority of issues submitted to the helplines were indeed due to local network and machine issues, where the local support for delegates failed to assist them appropriately. A few of the submitted problems came from users' failure with the practice interface, for example, one user failed to understand our instruction to press the play button (see figure 3 below) to start the audio stream. When we explained that this was designed to look like a conventional cassette tape control the user complained that *"... it doesn't look like my cassette recorder!"*
Delegates who failed to access the full interface were provided with an alternate very simple interface. This had all the speakers slides on one single page and launched the audio with an external helper application. No attempt was made to provide any of advanced features in this interface (eg. the slides and audio were not synchronised).

The Full Webcast Interface

The Graphics supporting the webcast were designed to be cached with the local browser. Whilst this was happening, the user was asked to be patient and to study the controls. In the control panel to the left we can see the logo at the top which links back to the main site page. Beneath this are the core control buttons which stop and start the audio stream, move to a previous slide or the next one, or open the chat interface to send a question to the symposium.

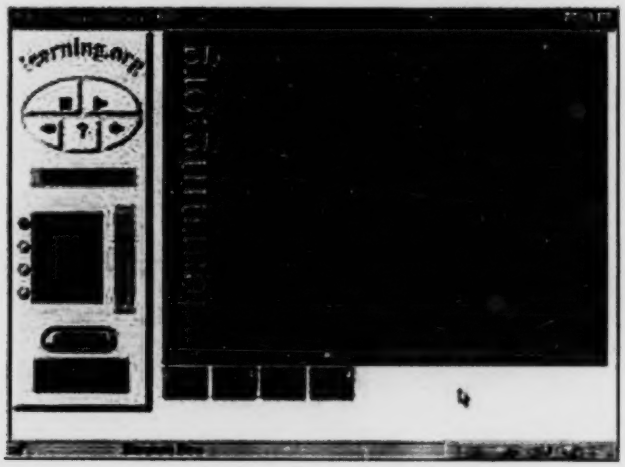

Figure 2. The Initial Welcome Screen

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Beneath this is the information bar (associated with the audiostream), the volume control, the channel/talk selector, the synchronise button and the slide information bar (ie. which slide am I looking at?).
Here we see a slide panel with a slide tray beneath. The user can jump ahead in the presentation by clicking the next or previous slide buttons on the main panel, or by clicking on a slide in the slide tray. The most difficult feature for users to understand is the synchronise button (here coloured blue). If synchronised, the remote client will be kept in synch with the broadcast speaker - when the speaker moves to slide 4, so do all synchronised clients. So, if you choose to browse ahead or behind the speaker you should be desynchronised, and when you wish to return to where the speaker is, you can simply press this button.
In figure 3 we can see the three speakers and the event producer seated around the table during the webcast. The producer sat at one pc - managing the discussion, and the speakers took the chair at the other pc to control their slides. The informal room layout was intended to aid the round-table (and remote!) discussion between the short presentations. The speakers themselves did not see the same interface that the remote clients did, instead they were provided with a control interface that simply informed the web event manager what they wanted the audience to see. In figure 4 we see a typical slide in the middle of a presentation. The channel selector indicates that this is talk 2 by Chiddick, and the slide is numbered 5 out of 11. Thumbnails of the 11 slides are in the slidetray - with the last (black) design being a holding slide for the discussion section.

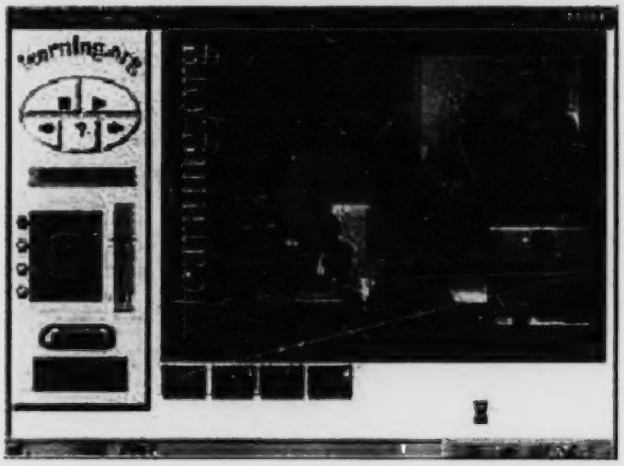

Figure 3: An initial context still image.

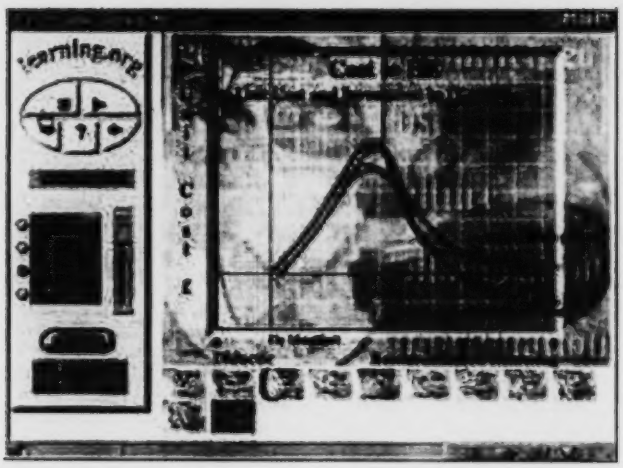

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Figure 4: Slide 5 in Talk 2.

Managing the Learning.Org Event

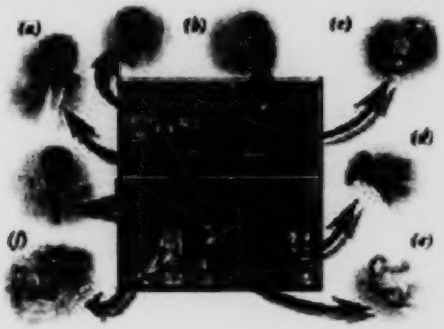

Figure 5: The Anatomy of the webcast.

Figure 5 shows a plan view of the layout used in the Learning.Org webcast. This is primarily useful to help illustrate the number of different roles and associated systems that were involved in making the event work. The event had three speakers (a) and a core webcast support team of 5 (b-f). In figure 5 (a) We see the broadcast speakers: Prof. John Arbuthnott, Prof. Diana Laurillard and Prof. David Chiddick. The speakers all shared one pc running the presenter interface. This interface communicated with the event server (d). The speakers audio was passed via radio mikes to the audio desk (c).

Figure 5 (b) Event Producer/Presenter. Dr Peter Scott coordinated the KMi Stadium team for the Learning.Org broadcast. He chaired the broadcast session, and handled the live questions. Peter was in constant text talkback communication with the whole technical team during the session. The producer/presenter must make the multi-speaker event flow smoothly, and must help the speakers to keep the audiences attention.

Figure 5 (c) Audio Support. The Open University AudioVisual manager, Andy Rix, was the audio technician. He mixed, balanced and monitored the audio streams. Andy's mixed audio was passed to the encoder (e). The quality of the event hinged on the quality of the audio - and so getting it right is a vital part of the operation.

Figure 5 (d) Web Event Manager. A KMi Stadium researcher, Mike Wright, was responsible for slide event management. Mike controlled the master speaker interface so that the speaker did not have to be concerned with what the audience was seeing. Mike could see both what the speaker was selecting and what the audience view would be. Both he and the Audio Master (e) shared a number of different monitoring views of the progress of the live event - the logs of who was listening; the server load charts etc. This is one striking feature of this style of event is makes it less like television and more like theatre - because one can "see" the audience, coming and going.

Figure 5 (e) Web and Network Audio Master. The KMi webmaster, Mike Lewis, was responsible for the Audio Encoding and Serving. For the live broadcast we used Progressive Networks RealAudio™ 14.4 stream encoded on a Win95™ pc and served from a Sun Sparc™. The instant replay was encoded at a variety of different qualities to use the Real Servers bandwidth negotiation.

Figure 5 (f) Graphic Design Support. The KMi Stadium Graphic Designer, Tony Seminara, was responsible for all the slides and interface graphics used in the presentation. The slides were all produced using Microsoft Powerpoint™ and all other graphics were Adobe Photoshop™ on an Apple PowerMac™. All of the speakers slides were redone to ensure a high level of quality.

Event Summary

Overall, the event was very well received and considered rewarding by both the presenters and the audience. A post event questionnaire was sent to all participants, although only 12 were returned. However the event was

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also heavily logged. Most of the participation statistics are in three quarters: about 40 delegates attended the physical meeting; about 75% of these took part in the live webcast (some of the others, viewed the instant replay), about 75% of these took part in the webcast discussion interface; and about 75% of this number answered our questionnaire! In the live webcast, not counting the numerous participants spread around the campus of the Open University (OU), our logs reveal that there were 20 different identifiable UK University sites (from Aberdeen to Wolverhampton) plus 2 unidentifiable sites and one participant from Portugal. This involved a total of 28 (non-OU) machines taking part. (There were 17 OU machines involved for some part of the session, of which 11 were in KMi). Most participants were alone during the webcast, but a few reported that they had collected together a small group (up to 8 people). According to the server logs (and questionnaire reports): of the 23 non-OU sites - 9 used the full interface throughout the session with no apparent technical problems. A further 9 sites appeared to have some minor technical difficulty, typically involving one reload of the interface during the session. Four sites mixed the simple and full interface - apparently with more serious problems. The remaining one site used the simple interface from the start. The data from the logs is very strongly correlated with the findings of the questionnaire survey. Most users reported some minor technical problems in initially getting to grips with the technology, but very few had serious problems, and most found the experience to be rewarding and informative (especially in the context of the topic under debate - strategically supporting IT in Universities!) With respect to the discussion generated during the one and a half hour session, (and filtering out a very small number of interactions of a technical or social nature), there were 15 identifiably different external participants in the questions and comments interface - who made 40 contributions to the debate. All contributions were clearly thoughtful and concise, averaging 44 words per contribution. This is an excellent result which clearly indicates a most serious and thoughtful interaction from participants, although some noted in the questionnaire that they found it challenging to type their contributions whilst keeping up with the broadcast discussion.
In the words of one delegate, *"... clearly a different medium from videoconferencing or live meetings in person - not a replacement. Certainly encourages informality - hence expression of ideas?"*

Conclusions

In many ways, the claim that it is useful to add value to physical meetings is an unsurprising one; particularly when the value discussed here is in terms of getting the slideshows presented before the physical meeting! Indeed any preparatory work of this kind is likely to be benficial. However, we argue that the nature of LIVE pre-event work is much more valuable. Delegates found the live pre-event webcast both compelling and interactive. The managers in this symposium were all fairly motivated to contribute, and the technology itself was a prime example of the topic they were discussing! However, the live event focused them on a specific time that they had to give to this activity and promised them the ability to contribute, at that (real) time. Furthermore, combined with a physical meeting that was socially designed to minimise one-to-many lectures and maximise many-to-many face to face interactions based upon the material that had been previously covered, makes the model very compelling.

Acknowledgements: The symposium was conceived by Prof. Diana Laurillard and executed with the excellent assistance of Jacqueline Eisenstadt and Alison Nash. Other contributors are acknowledged directly in the above.

Making a Difference -- from Prototype to Completed Project

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Abstract: Historically speaking, information development (ID) writers are the last on the block when it comes to involvement in product interface design. We writers quite often find ourselves frantically documenting a rather unfriendly product, and trying to disguise the problems and irregularities of the product's interface. "Fix it in the pubs" is a well-known expression. Things are changing though, and mainly because we now take a more proactive role in providing value add early in the product cycle. And, yes, we still write user guides, installation guides, programming references, quick references, and help text, but we also bring a wealth of usability and Web skills to the table. Today, we can take it full circle by not only writing and editing documentation for new product offerings, but also by providing usability testing of product interfaces, making suggestions for improvements, designing interface prototypes, and developing online demos. We'd like to present a scenario, which (although not about a real product) demonstrates the shared experiences of ID writers in today's corporate environment. In this scenario, we discuss how information development's contributions helped improve the design of a new e-BIZ product interface. We'll show how this unhappy interface was rescued and salvaged by a dauntless team of programmers, product developers, testers, and Web-designing information developers. The scenario also illustrates our *one team* approach to delivering a product that delights our customers. We'll trace information development's involvement from early documentation through usability testing, prototyping, designing, and delivering an improved product interface.

Getting Involved

One Team

About a year ago, our information development (ID) manager was asked to provide some editing assistance for the documents relating to a new e-BIZ Web project. The project was destined for selective, or limited, release within a couple of months. Our manager agreed that someone in the department would edit an online user's guide and help text that had been written by developers and programmers. Little did any of us know how very involved ID would get and how extensively we would help shape this new project.

Although ID prefers to be involved early in any project cycle, being asked to participate after a project gets underway is simply business as usual. When we do have the good fortune to be involved early, it allows us to positively and creatively influence the design of the interface. Of course, the way an interface looks and works directly impacts what is said about it in the related documentation. The selective release of the e-BIZ Web project was on a very short to-the-market schedule. And, because of this tight schedule, ID's influence on any design issues was minimal.

The developers and programmers for the e-BIZ Web project were located in Schaumburg, Illinois, and ID was in Tampa, Florida. Our project communications were most often by teleconference, video-conference, or e-mail. The project team included various participants from ID, Marketing, Program Management, Customer Support, and others. Early on, the developers presented education classes for the project team in Tampa and at other supporting locations. Everyone involved was caught up in the excitement of learning about this new Web project. The team also attended weekly Project Execution Team (PET) meetings, which were held to track the progress of all the project activities and deliverables. The PET's unified goal was to execute project delivery with precision and speed -- and as one team.

Write, Edit, and Rewrite

Initially, Schaumburg developers sent the Tampa editor hardcopy printouts of the e-BIZ user's guide, help text, and screen captures of the project interface. The editor's job was, for the most part, to catch any "gosh awfuls" and to edit for inconsistencies, typos, misspellings, grammar errors, etc. Figure 1 illustrates some of the editor's markup and suggestions.

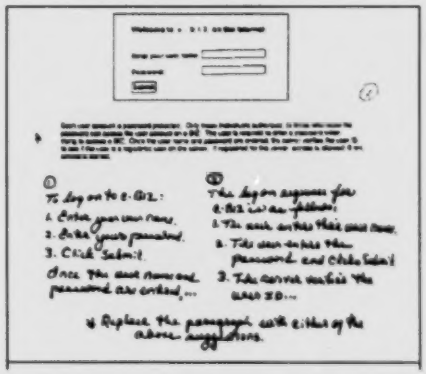

Figure 1: Sample of Editorial Markup

The editor returned the markup package via express mail to Schaumburg. Not too high tech, but quite effective all the same. Along with the markup, the editor always mailed an itemized laundry list of suggested improvements, if not for this release, then for the next one. The developers keyed the changes in, and, as time allowed, the corrected text was reviewed again by the editor. Our participation in the selective release, though minimal, was quickly recognized as beneficial and our role was soon to be expanded in the formal release.

Selective Release

The pace was frantic at times, but the selective release of the e-BIZ Web project occurred on schedule and with all deliverables in place and on time. But, even before the release became available, our marketing and service organizations realized that the project required some serious usability and interface design enhancements. The lead developer had hoped to obtain the services of a Web design consultant, but because the schedule was too aggressive to accommodate any major redesigns, the matter was dropped for the moment. To meet the tight schedule requirements, it was not unusual for many on the project team to work evenings and weekends. This

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included the lead developer, who once said, "This project has to meet its schedule, come hell or high water." Then, while pointing out the window at the dark clouds, she added, "And it's raining right now."

Usability Evaluation

Once the selective release became available, we approached the service manager and lead developer and suggested that our department conduct a usability evaluation of the interface. By then, the development team was feeling less pressure, and they welcomed our assistance. They not only wanted the usability evaluation of the current interface, as illustrated in Figure 2: they also wanted us to further refine and improve the existing e-BIZ documentation. This included the online user's guide and help text originally edited by our department editor.

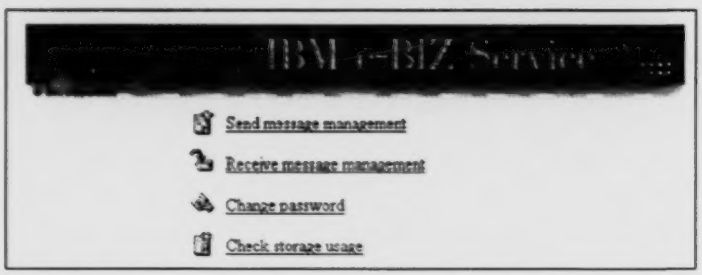

Figure 2: Original Interface of the Project Menu

In response, our ID manager assigned a usability team to perform a complete usability evaluation; she also assigned a subset of that team to rewrite the help text and user's guide. The lead developer gave us individual passwords so we could have hands-on access to the Web project interface to test links and evaluate function. We spent about a week testing individually and as a group. We met several times to review the interface together and to discuss our findings with one another. After a thorough review, we prepared and presented a report that focused on making the interface more intuitive by using common terms and descriptive text. Additionally, in the same report, we identified some problem areas in the online user's guide and help text.

Documentation Reviews

With the usability evaluation turned over to the developers and programmers, we began the task of reorganizing and rewriting the online user's guide and help text. We started by reviewing the existing help text and online user's guide. We found this documentation, though very well handled, quite abbreviated and lacking in some key areas. For example, the first view, or page, of both the help text and the user's guide was always a content page, as illustrated in Figure 3. From this content page, you had to click several links to navigate to the information you wanted. We also found that unique help text did not display for each Web project page and that you could only access the user's guide from the first page of the Web site. Also, the information was contained in Lotus Notes databases and had very few hypertext links. Our first recommendations were to provide the information in HTML, add more hypertext links, and make the help text context sensitive. Here, again, we were finding that in order to improve the documentation, we had to improve the interface -- they were directly related.

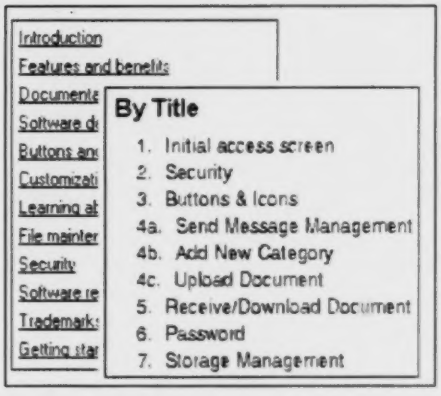

Figure 3: Original Views of the User's Guide and Help Text

Our documentation reviews with the developers and programmers were conducted at about the same time we completed our usability evaluation. This was rather fortunate, because our documentation reviews quite often turned into usability reviews of the interface as well. Observations made during the usability evaluation prompted us to make many suggestions during the documentation reviews. The developers and programmers favorably and even enthusiastically received these suggestions. Our contribution was clearly making a difference.

Staying Involved

Design, Review, and Rework

We had several review meetings as we made changes to the user's guide and help text, not only to ensure accuracy but also to discuss additional changes with one another. Our review meetings quickly became informal design sessions where we all felt free to suggest changes to terms, page flow, and functions. For example, when we pointed out that a particular function was not easily accessed, the developers were there to advise how to implement the fix in the user's guide, the help text, the code, and the user interface. Of course, it wasn't just the writers making suggestions -- everyone on the team contributed. The team consisted of Marketing, Development, Service, Customer Support, ID, and others. Some of these people worked with customers on a daily basis and identified specific problems or concerns that customers reported.

Putting It on Paper

One day, as we prepared for one of our documentation review meetings, we decided to try our luck at sketching a mock-up or paper prototype of some redesign possibilities for the Web project interface. This was in no way required of us; we simply saw the need to try. The way we looked at it, we could either find problems and report them, or we could find them, report them, and suggest solutions. We chose the latter.

We started by sketching out a paper prototype of the entire project interface. Using common art materials, such as markers, paper scissors, transparency tape, etc., we quickly constructed a fully functional paper mock-up of the project interface. A paper prototype provides a means to obtain maximum feedback with a minimum of effort. It lets you evaluate your product design to find out where the design works and where it needs refinement. For us, it provided a way to try out our ideas without developing a complete Web site. Note that our initial redesign of the interface had very humble beginnings, as illustrated in Figure 4.

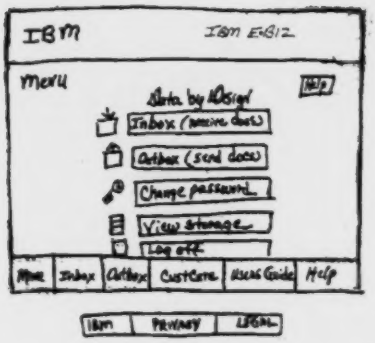

Figure 4: Early Paper Prototype Sketch

From Paper to Prototype

During one of our documentation reviews, the paper prototype was passed around to the team and faxed to the developers in Schaumburg. We had a dozen or more individual examples for them to review. Everyone seemed to think the prototype had promise; however, the developers were still very busy and weren't exactly sure how the paper sketches would look as a finished product on the Web. So, after a little more designing and drawing, we brushed up our NetObjects Fusion skills and began to create an online prototype, as illustrated in Figure 5.

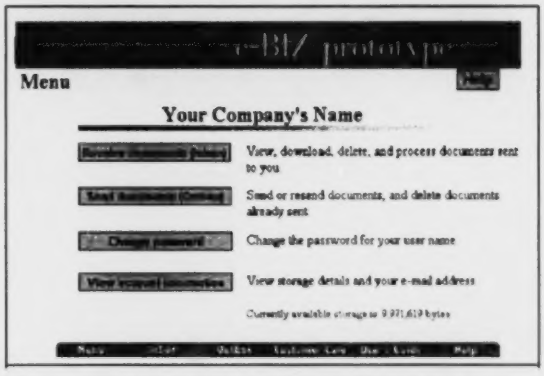
Menu
Your Company's Name
View, download, delete, and process documents sent to you
Send or resend documents, and delete documents already sent
Change the password for your user name
View storage details and your e-mail address

Figure 5: Project Menu for the e-BIZ Prototype

From Prototype Designers to Consultants

When we put the polished prototype on the Web, we added a feedback form to capture comments from the rest of the team and other reviewers. Soon, we were receiving feedback comments and notes. We learned that the developers had previewed the prototype on the Web with some current and prospective customers. The preview resulted in positive and encouraging feedback. We had more meetings to discuss all the comments received before we again revised the prototype. And, based on this last revision, the developers began to update the e-BIZ Web project pages with the prototype design. The developers continued to contact us when they wanted to add new functions, and asked us to help design any related interface changes.

Finishing Touches

Now that everyone on the team agreed on the terms and functions for e-BIZ, we went back to our real assignment: the user's guide and help text. It was time to make sure the final version of each would be viewable from the Web site. We developed the help text within a Lotus Notes database by adding HTML tags in the

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database fields, and the developers created an application for updating helps directly to the database on the development server.

The user's guide was a little more complicated. We developed it with FrameMaker so we could also provide it as a PDF for those who wanted to print the entire book at one time. Fortunately, we learned of a product called WebWorks Publisher, which works very well with FrameMaker to automatically convert Frame documents to help and HTML files. After several calls to their Technical Support group, we had the user's guide converted from FrameMaker to HTML, as illustrated in Figure 6. We finished converting and testing it one day before the general availability date.

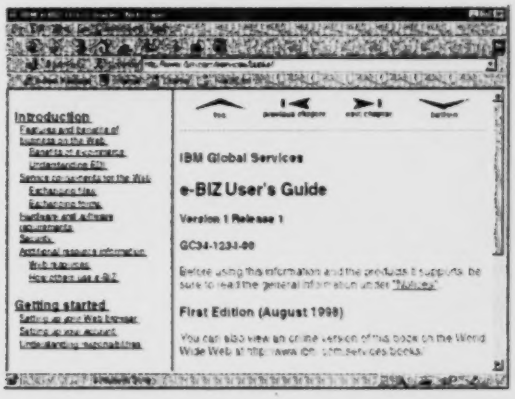

Figure 6: Initial View of the New and Improved User's Guide

A Happier Interface

We completed the review cycle for the documentation, and the user's guide and help text were available and on time for the formal release. The outcome was good. The help text and the user's guide, which would still benefit from the versatility provided in a Lotus Notes database, now had underlying HTML code. The help text was now context sensitive, and the user's guide was readily available throughout the e-BIZ Web site. But most importantly, as illustrated in Figure 7, we contributed more than the standard documentation; we contributed to a happier interface.

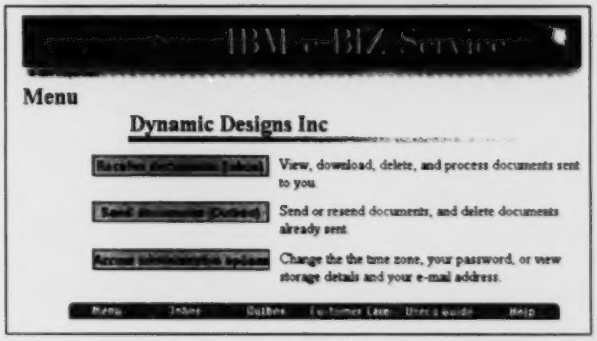
Menu
Dynamic Designs Inc
View, download, delete, and process documents sent to you.
Send or resend documents, and delete documents already sent.
Change the the time zone, your password, or view storage details and your e-mail address.

Figure 7: Final e-BIZ Project Menu

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Online Assessment with the QuizCenter: Tools for Distance Education

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Abstract: The Maui Educational Technology Research and Development Center was initiated in 1995 with the purpose of finding ways to integrate existing technology into distance education. One of the tools developed by Maui Ed Tech is the QuizCenter – a free service for educators, which provides a quiz creation and correction engine to assist in assessment across the World Wide Web. This paper summarizes the evolution of the QuizCenter, and the success it has currently attained. The simplicity of the QuizCenter and Ed Tech's focus on the "low-end" user, have worked together to furnish a solid product that serves hundreds of teachers to this day.

Distance learning is the most rapidly growing area in higher education today. According to a survey conducted by the U.S. Department of Education, one third of all higher education institutions in the United States were offering some form of distance education in 1995, and a quarter were planning to begin offering distance education courses within the next three years [Greene 1997]. Besides the obvious financial rewards to be gained from offering courses to students beyond the campus population, there is a certain satisfaction in bolstering the academic community at large --- the exchange of knowledge in spite of physical boundaries. This exchange has become logistically possible for the first time in history.

Teleconferencing and Internet technology have bridged the chasm of space and time for the sake of expanding education. The World Wide Web in particular is becoming a most valuable medium for the distribution of course material, and educators are being pressured to incorporate the resources of the Web more readily in their courses. Unfortunately the technology is still relatively new, and there is a scarcity of proven tools and methods at the disposal of teachers who are just beginning to use the Web. More so, teachers by and large exhibit a lack of technical expertise in what they perceive to be a road that can only be traveled by "computer gurus".

With this in mind, the Maui branch of University of Hawaii Office of Technology Transfer and Economic Development (UH-OTTED) initiated a program called the Maui Educational Technology Research and Development Center on October 4, 1995. The purpose of Maui Ed Tech was to investigate strategies in which existing technologies, including the World Wide Web, could become more usable and more attractive to teachers involved in distance learning at all levels of public education. One of the most successful projects to arise out of this endeavor is the QuizCenter, a tool and service for online assessment. The QuizCenter provides a mechanism for instantaneous creation and correction of web-based tests and quizzes without requiring any knowledge of HTML programming. Through a simple and straightforward form-based interface, the user enters standard quiz information (length, type, etc.) followed by the question and answer text. With this information, the QuizCenter immediately compiles the user's quiz and stores it on a server for later retrieval via a World Wide Web browser. Through this engine, the QuizCenter facilitates the adaptation of existing course material to the Web.

Development of the QuizCenter was geared towards the low-end user: the educator with the most basic knowledge of a Web browser. No assumptions were made beyond this. Instructions for QuizCenter usage and error diagnostics steered clear of technical jargon. Extended documentation on even the most trivial items was readily available and

easy to find. A logical sequence of events was maintained at all times during the quiz creation process and physical glamour was minimized in order to accommodate educators using less sophisticated computer equipment. The software was first released in August of 1996 as a server-installable package that was free for download. Although more than one hundred institutions downloaded the software over the next year, UH-OTTED was surprised to discover that many teachers involved in distance education could not be serviced through this arrangement because they did not have access to a web server at their institution. Although their schools had committed to establishing distance education programs over the Internet, they were missing the proper infrastructure. Keeping with its intentions to meet the needs of the lower end, UH-OTTED converted the QuizCenter into a free on-line service for educators wishing to integrate assessment into their distance education courses.

On August 1, 1997, UH-OTTED set up an independent web server with the sole purpose of operating the QuizCenter. Any teacher affiliated with a valid educational institution was invited to apply for an account that would enable them to freely utilize the QuizCenter on this server. An email address was the only requirement. UH-OTTED would supply disk storage for the teacher's quizzes and answer keys, as well as technical support, server maintenance, and product updates. All quiz activity would take place on UH-OTTED's Maui server, which benefited from a high bandwidth connection through the Maui High Performance Computing Center. Direct access to this server was restricted to the UH-OTTED office staff only, thereby enhancing quiz security and privacy.

The response to this free service has been far more overwhelming than UH-OTTED imagined. Just eleven months after the QuizCenter Service went online it serves over 1000 educators, from 800 different public and private institutions, at all grade levels, in all 50 U.S. states, and 30 countries. Subject matter is widely varied and user feedback has ranged from quiet approval to positively glowing. UH-OTTED believes that the success of this venture has been the direct result of its specific audience target. Most QuizCenter users do not have a web server at their institution, and those that do lack the skill to produce and/or operate similar quiz products. However, they and their students have access to the World Wide Web through local and national Internet Service Providers both at home and on campus. They have embraced the QuizCenter Service as an easy and practical solution to the challenge of providing a means to evaluate learning on the Web. Teachers have found the QuizCenter to be especially useful for creating practice tests as study guides, and for delivering make-up tests to homebound students. Although the majority of QuizCenter users have been most comfortable with a basic question-answer format like that of paper-based quizzes, there are also a number of features which have allowed more Web-savvy educators to compose self-contained learning modules that include graphics and hyperlinks.

As distance education continues to expand, so will the QuizCenter. Several features were added in response to user suggestions, and on March 20, 1998, UH-OTTED released a licensed version of the QuizCenter software for institutions that wished to install the system on their local server. The popularity of the QuizCenter grows each day and is expected to serve over 1500 educators by the end of 1998. Its ease-of-use and focus on the lower end of the spectrum continues to attract attention, and word is spreading fast among distance education circles. The QuizCenter Service is quickly becoming a very proficient tool for assisting in the transition to more effective distance learning.

More information on the QuizCenter Service can be found at http://motted.hawaii.edu.

Reference:

[Greene 1997] U.S. Department of Education. National Center for Education Statistics. *Distance Education in Higher Education Institutions*, NCES 98-062, by Laurie Lewis, Debbie Alexander, and Elizabeth Farris. Project Officer, Bernard Greene. Washington, DC: 1997.

Painting on the KidsWall - Computer Supported Cooperative Play
Work in Progress

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Abstract: Children should not be restricted to solitary activities when using computers. An applet-based cooperative drawing program provides children with the tools to collaborate on a creative project and allows us to investigate further the concept of Computer Supported Cooperative Play.

Introduction

The World Wide Web provides lots of information but very little in the way of constructive interaction. Children who use the Web are either browsing for entertainment or searching for specific information. As part of a push to encourage children to use the Web in an interactive and cooperative manner we are developing a multi-user drawing environment.

The skills of drawing and composition are both developmentally useful and natural for children, not only do they provide a way of recording perceptions of the environment, concepts and feelings but they are also a major source of creativity. Drawings allow children to express their relationships to objects in the world at the same time as gaining control over the tools of pencil and paper (or computers). Collaboration is also important for cognitive development [Vygotsky 78], particularly the interaction which is required to make collective decisions and resolve conflict.

Some art forms include the need for cooperation in their production. Wall charts are examples of this from primary school classrooms, in which several children produce pictures which are added in appropriate places on a background produced by others. Typical subject matter includes: life on the seashore, travelling to the moon, city or land scapes, forests, and village life.

We are developing a program which provides a Web-based collaborative environment to produce this type of wall chart. The design attempts to foster cooperation while allowing individuals to work on sections by themselves. A hierarchy of access rights encourages children to decide how they want their work to be used by the group.

Computer Supported Cooperative Play

Very little research has been done on Computer Supported Cooperative Work (CSCW) for children. Since the work of children is play, we suggest the area could be called Computer Supported Cooperative Play (CSCP), especially as it relates to younger children.

Related work includes the NICE project [Roussos et al. 97] which requires collaboration in a highly structured virtual world and "single display groupware" [Stewart 97] which allows multiple use of the same computer and screen. Also, many games now allow modem or network connections. Not surprisingly, many multi-user games are designed for competition between the participants, using the computer as a playing field and umpire. But even some of these can be played cooperatively.

KidsWall

To investigate Computer Supported Cooperative Play we have designed a cooperative drawing environment called *KidsWall*. This is an applet-based wall chart producing system. Any art work which requires separate objects on larger backgrounds can be produced in the current system.
The program tries to emphasise the two poles of collaborative work. The children have to work together to complete the task. They must communicate to make decisions about who does what and the final appearance of the chart. Secondly there is individual responsibility. Each child has to produce his or her own areas of the chart.

Implementation

There are two types of object which can be worked on: backgrounds or stickers.
The type of background can either be a layered one or a sectioned one. The layered background allows multiple layers with appropriate transparent areas. One child could work on the distant background, another on the middleground and so on. With a sectioned background several children can work on different non-overlapping rectangular areas.
The stickers are the objects which are stuck on to the background. They can range from items of text to complex illustrations.
There is a variety of access rights to stickers and backgrounds. If children really don't want someone else altering the object they are working on they can restrict access to *as is*. With this access type other children can use the object, in the sense of copying it and positioning it in a background, but the editing facility won't allow them to alter or add to the object. Other rights are *changeable* and *copyable*. If the object access mode is *changeable* it is possible for any child to alter the object. The *copyable* access right is intermediary, it means that others can make changes to a copy and save this as their own object. The original stays undisturbed.
After the production of backgrounds and stickers comes the construction phase; the placement of backgrounds and stickers on the backgrounds. As there is only one wall chart produced by the system, the users have to cooperate and make compromises on its final appearance.
One important facility we have included is the ability to see who is responsible for which sticker or which part of the background. There is a pane with names and pictures of each user. Selecting a sticker from the sticker view or a background from the background view automatically causes the owner of the work to be highlighted. Similarly selecting a user causes all objects or backgrounds owned by that user to be highlighted.

Advantages over Traditional Media

KidsWall can easily be used on school intranets or distributed over the Internet. This provides access for children who may be physically isolated from others, either in remote areas or confined to hospital beds. This gives the opportunity of play with other children but is different from most network or modem connected games because the play is by its nature creative and not competitive.
Apart from the remote access facility there are other advantages in using *KidsWall* over conventional paper and pen wall charts. Children can work on the same area of the drawing without physically getting in each other's way. Children can easily share each other's work. One drawing object can be copied and placed in many different positions on the chart. Transformations such as reflection, rotation and enlargement can be applied to these copies to add variety and a sense of perspective.
Using an applet-based system means that connection is simple. The applet server also acts as the repository of all objects and backgrounds and the final chart. Each sticker, background and complete chart can be printed by any participating machine.

Current Communication

By allowing the possibility that the children working on the project together can be in separate places we have to provide some method of communication between the children so that they can discuss ideas and negotiate solutions to differences of opinion. The current version of *KidsWall* is only designed to work where children are in the same location but could be augmented with an audio or video link.

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Beyond Web Middleware

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Abstract: The Web's ease of use and ubiquitous presence gives organizations the opportunity to deliver information to new audiences of end-users. Web middleware has proven to be useful for recycling existing databases and legacy applications into formats that can be delivered to browsers. This session will look at how organizations can use Web application servers to go beyond passive middleware and create new applications by actively recombining existing enterprise data and information content to provide high-value Web applications customized to meet the information and usability requirements of the Web end-users.

Developing Courseware for Mathematics and Computer Science in JavaScript

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Abstract

JavaScript allows rapid development of educational web pages for mathematics and computer science. Several examples of such pages are presented. Translating entered information into JavaScript or HTML is an easy way to implement sophisticated interactive pages.

This paper describes the advantages of using JavaScript for educational software and some techniques for writing powerful educational JavaScripts. I also refer to several powerful educational tools that I wrote in with JavaScript, in particular, the graphing calculator (http://polar.sunynassau.edu/~sherd/sware/local/gcalc.htm), the C++ code simulator (http://polar.sunynassau.edu/~sherd/sware/local/cpp.htm) and the HTML tutor (http://polar.sunynassau.edu/~sherd/sware/local/html/talkhtml).

This paper discusses how JavaScript helps an instructor build interactive content into his web pages. Because the interactive content is run from the client side the response can close to instantaneous, and rapid feedback is preferable for a teaching tool. I show how the power of the language allows one to build simple powerful tools that can illustrate a wide variety of topics for a class.

JavaScript is a powerful language for developing educational software. Its advantages are:

- JavaScripts run on any platform with a sufficient web browser (Netscape 3 or Microsoft 4)
- JavaScript is an interpreted language yielding these advantages:
  a) It is compact so it loads quickly. b) It requires no additional software for compilation. c) It runs on the client machine, so using a JavaScript web page creates no additional load on server.
- JavaScript is an object oriented language; this eases the design of web pages.
- JavaScript objects easily interact with html code.
- Similarity to C and C++ allows interpretation of simple C and C++ code for teaching computer science.

I have designed a graphing calculator in JavaScript, overcoming the limitations on interactive graphics in HTML (see figure 1) (http://polar.sunynassau.edu/~sherd/sware/local/gcalc.htm). This tool can calculate and graph most common functions. It contains an efficient numerical calculator and it can rapidly evaluate functions. We can use this tool to teach about functions and mathematical modeling. However building a graph requires loading individual images for each pixel of the graph, which can require excessive memory and time. However, the other advantages compensate for these weaknesses. The main difficulties lie in weaknesses in the web browser code rather than in the web page. As web browser code grows more efficient and bugs are removed these pages will become more effective.

The advantage that I would like to emphasize in this paper is that JavaScript is an interpreted language. The language has a function called *eval* that allows the user to execute a string in JavaScript. This means that one can construct and execute new code fragments within a JavaScript program. The calculator and the C++ simulator are based on this capability.

In particular, the C++ simulator (http://polar.sunynassau.edu/~sherd/sware/local/cpp.htm) (see figure 2) translates the code in the source window into JavaScript. Since JavaScript and C++ are similar languages very little translation is necessary. Since my simulator is meant to teach CS1, I only gave it the capability to translate simple C++ code fragments. Once the code is translated it is then executed with the *eval* function.

Similarly the functions entered into the graphing calculator are evaluated. The main translation required was introducing ^ as the exponentiation operator (since JavaScript lacks one). For example, the code to calculate an expression (from http://polar.sunynassau.edu/~sherd/sware/local/calc.js) is:

```
function calcString(str) {  // Used to implement client side calculator
  with(Math)
  { pi = PI;  /* define pi */ e = E; /* define e */
```

```
    resultval = eval(exponentiate(implicitMults(removeSpaces(str))));}
  return resultval;}
```

Three functions massage an expression string to the point where it can be executed as a JavaScript expression:

- `RemoveSpaces` — removes all the white space from the expression.
- `implicitMults` — inserts multiplication signs (*) wherever it is implied (for example 2x becomes 2*x).
- `exponentiate` — translates expressions of the form x^y to pow(x,y).

Thus, I built a sophisticated calculator by writing some simple string manipulation code to translate expressions into JavaScript.

The HTML tutor is another variation on the same theme. It passes information from the student to the web browser's HTML interpreter. The students use this page to experiment with HTML and thus learn by doing. The HTML tutor accepts HTML in a text area in a frame and writes the HTML, with a preamble and a conclusion in another frame. The web browser interprets the student's HTML. The student can do exercises in HTML within the web page. The code to implement this is trivial:

```
<!--Hide JavaScript from Java-Impaired Browsers
function pushHtml() { // pushes html to output screen
  parent.Out.document.clear(); // parent.Out is the frame for output of HTML
  parent.Out.document.writeln('<HTML>\n<BODY text=black bgcolor=cyan>\n<H4>
Your HTML:</H4>'); // preamble
  parent.Out.document.writeln(document.Entry.HtmlInput.value) // user input
  parent.Out.document.writeln('<BR>That was your HTML</P>');//page conclusion
  parent.Out.document.writeln('</BODY></HTML>');}
//-->
</SCRIPT></HEAD><BODY bgcolor=beige text=A00000>
<FORM Name=Entry> Type HTML here:
<Input type=button Value="Display Your HTML" OnClick="pushHtml()">
<TextArea Name=HtmlInput Rows=4 Cols=40>
</TextArea></FORM>
```

The user input does not need to be modified since the language being taught is native to the web browser. The users of this page can see how their HTML would display instantaneously and accurately. The instantaneous response is superior to the earlier version of the HTML tutor that used forms and CGI.

Interactive content can be incorporated into Web materials directly or though links. The page, http://polar.sunynassau.edu/~sherd/sware/local/pcalnote.htm, combines several techniques. On the top of the page it puts up a frame with a JavaScript numerical calculator, thus providing a frame with a specialized interactive web page in it. To the right of the calculator is a frame with a link to the graphing calculator, thus providing a link to an interactive web page. The third frame in the page contains lecture notes that contain some interactive content in lesson 1. This interactive content is directly embedded in the material. It also contains some links to interactive content from myself and from the Bloomberg information service (a currency calculator: http://www.bloomberg.com/markets/currency/currcalc.cgi). This page combines a variety of methods of allowing students to interact with the course content through the World Wide Web.

There are many advantages to using JavaScript for educational web page design but the most useful feature I have found is the *eval* function and variation thereupon. Other advantages include speed of loading and rapid client side response. I illustrate these advantages with references to a variety of web pages that I designed. I also explain some code fragments in JavaScript that show how to take advantage of the language to build powerful tools.

Acknowledgements

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A Technology Partnership with a High School for At-Risk Students: What the University Has to Offer

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Abstract: Beginning in Fall, 1997 Indiana University South Bend engaged in a partnership with Hamilton Alternative School, a new public alternative school for at-risk high school students. This paper describes the planning and implementation of a technology plan and classes in technology for this student population. Findings suggest that without basic literacy skills, students' ability to benefit from technology will be seriously effected.

1. Introduction

This paper describes the establishment and implementation of a technology partnership between the Division of Education at Indiana University South Bend and Hamilton Alternative School, a new public alternative school for at-risk high school students. At-risk high school students are generally defined as those who, for a variety of reasons, are at greatest risk of not completing their high school education. Reasons for dropping out of high school include academic, social, and economic factors as well as educational needs not met through a traditional high school curriculum. The students enrolled in the school applied for admission and were recommended by their local public schools. The main criteria for acceptance were that the students wanted to graduate from high school and were believed to be in danger of dropping out of their more traditional high schools.

2. Background

Through a special grant from the President of Indiana University, a two-year grant was funded to enable university Education faculty to work closely with the alternative school faculty and students. A needs assessment of both faculty and students identified the area of technology as the highest priority, and a Technology Plan was developed to meet these needs.

While the school had a computer laboratory, due to limited staffing at the school, the lack of an adult supervisor prevented students from using the lab. Initially our efforts were aimed at staffing the laboratory with qualified university students so that the high schools' teachers could send their students to the lab for access to word processing and the use of the WWW for research materials.

At the same time, in cooperation with the school, the University Liaison became the Technology Coordinator with the responsibility for establishing an implementing the Technology Plan. This plan included both assessing and purchasing hardware and software needed for the computer lab and individual teachers, as well as developing a technology curriculum and a plan to work with the school's teachers to integrate technology into the school curricula.

3. Findings

In the second semester of the partnership, a technology class was offered, jointly taught by the Technology Coordinator and a university student for those high school students who had expressly requested such a class. Data on the students enrolled in the class were examined with respect to reading and mathematics achievement, learning styles and right/left hemispheric preferences. Despite traditional research which suggests that the highest school dropout rates are among the more hands-on, common sense type of learners, we found that the technology class attracted creative learners, social learners, and school-analytical learners as well as the hands-on types. While more male students tended to be the active, hands-on learners, the technology class appealed to all types of female learners. In terms of ability, the technology class was requested by students from a wide variety of achievement levels in reading and math. However as the semester progressed in the class, we began to see how low ability in reading, and particularly in writing, effected the kinds of activities which could be conducted in the class. As an outgrowth of our concerns, we began to offer special reading and writing help for those students with limited literacy skills. Our findings suggest that for those students without basic literacy skills, their ability to benefit from technology training will be seriously effected putting them at even greater risk of not succeeding in our increasingly technology society.

At the conclusion of year one, the goal of a fully equipped computer laboratory with Internet access on all computers and appropriate educational software has been achieved. With a new generation of computers in the lab, more dated equipment has been placed in English and science classes to be utilized for work in these classes. We have also established a curriculum for an introductory technology course elective for students. In year two of the partnership we will continue to work with the school faculty and students in offering introductory and possibly more advanced technology electives into the curriculum. We hope to provide technology training for those teachers with limited technology skills and devote more time in working with teachers to integrate technology into their course content.

Developing a Proxy Server to Translate Japanese Web Pages into Plainer Japanese Sentences

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Abstract: Using Web pages for supplemental materials in the classroom is very popular. However, some Web pages are not suitable for education as their stuffy description. Our research aims at translating these formal web pages into plainer Japanese sentences. We provide the system as a proxy program running on UNIX workstation. The system consists of three phases - morphological analysis, transformation, and mark-up. It is expected that students can read web pages easily by using our system.

Introduction

There are many culturally oriented web pages, such as those pages produced by museums, galleries, libraries. They are suitable for supplemental materials in the classroom. However, the purpose of these

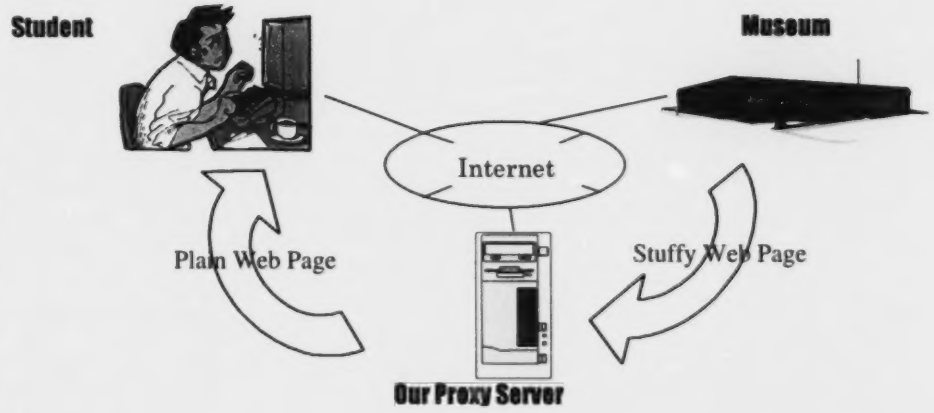

Fig. 1:Overall System

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pages is not always for educational use only. Often, an overly formal or "stuffy" language-style is used in conveying information. Students sometimes hesitate to read these formal language descriptions. Our research aims at translating these formal web pages into plainer sentences in order to better suit students' abilities and understanding.

A Proxy Program Overview

Figure 1 shows the overall system of our proxy program. When students access any web pages that they have difficulty with, they can use our proxy server to translate the web pages into plainer sentences.

Figure 2 shows the flowchart of our proxy program. As shown, the translation process consists of following three phases.

(1) Morphological analysis:
In Japanese sentences, we can determine the part-of-speech of each word by morphological analysis. The part-of-speeches are used in following two phases.

(2) Transformation:
The syntax of the input sentence will be changed according to transformation rules (described below) in order to be easier for students to read.

(3) Mark-up:
Difficult terms are detected and marked-up with HTML tags. Users can search for meanings by utilizing search engines or on-line dictionaries.

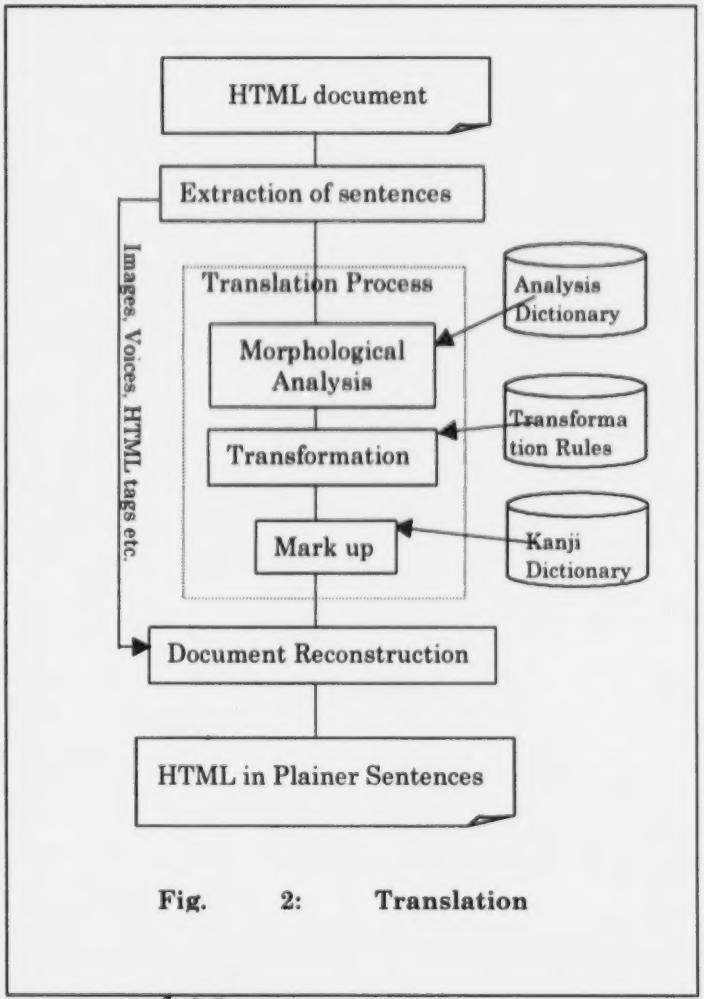

Fig. 2: Translation

Transformation Process

Transformation is the main phase of the translation process. In this phase, an input sentence is transformed according to the transformation rules expressed in Context Free Grammar. Simozono has been developing a Japanese critiquing program "SUIKOU" which points out difficult-to-read sentences [Simozono et al. 1994]. To date, we have defined seven transformation rules according to the experience of "SUIKOU". These seven rules can be categorized into the following three functions:

(1) Sentence length adjustment:
If a sentence has more than ten phrases, the sentence will be divided at a conjunctive auxiliary into two sentences. This rule will supply a conjunction between the sentences.

(2) Formal expression replacement:
There are several formal expressions in Japanese sentences. "Formal expression replacement" replaces those expressions that contain adverbs and auxiliary words, as they are function words. Function words create a "stuffier" sentence than content words do. This rule replaces the formal syntax, which is determined by adverbs and auxiliary words, with a plainer syntax.

(3) Compound noun phrase transformation:
Similar to English, Japanese sometimes uses long compound noun phrases. This category of rules inserts "no" (similar to "of" in English) at appropriate positions in order to make a phrase easier to read.

Mark-up Tags for Difficult Words

There are many technical terms in web pages. Our approach is to mark-up difficult terms with HTML tags. The user can then open a link to yahoo.com, or an on-line dictionary, by clicking on these terms. Optionally, we can replace difficult terms with easier expressions. However, these expressions may contain the main theme of the web page. Also, too much added description may cause the reader to become frustrated. Utilizing our proxy system, users can specify the difficulty-level so that the program can automatically mark up text, thus giving the user a number of options to selectively control the proxy program's functioning. Currently, we have catalogued approximately 6,000 Kanji characters, divided into various levels of difficulty, in order to create optional levels of automatic selection and descriptive narration for the user.

Translation Level Setting

Students sometimes feel boring while they are reading so plain documents. We provide the translation level setting in order to change the sentence difficulty level. There are three levels to select the difficulty. Level 1 is for elementary school students. Level 2 is for junior high school students. And Level 3 is for high school or university students.

Consideration

In this section, we will discuss the advantages and aspects of our approach.

(1) Usage
Students can easily use our program because our program is developed as a proxy program. Once students specify our server as a proxy server, they will get translated web pages without thinking.

(2) Performance
Our proxy program's process is light because we only use morphological analysis. Unlike semantic analysis or syntax analysis, the morphological analysis is very fast and reliable.

(3) Transformation Rules
We have defined seven transformation rules. However, we have to add some rules in order to improve the accuracy of the translated web pages.

(4) Dictionaries

We provides two dictionaries, analysis dictionary and kanji dictionary. To improve the mark-up function of this system, we must re-organize kanji dictionary to involve the compound kanji sequences which make words of noun.

(5) Mark-up

To mark up difficult words is for searching for words in a dictionary or searching for related items in web pages. It is necessary to build a web based dictionary for users of this system in order to use this easily.

Conclusion

We have described our proxy program to translate web pages into plainer language. Our program is designed to help students utilize cyberspace as an educational tool for sourcing out information related to classroom presentations and learning. Using our proxy program, students will not have to hesitate at formal descriptions, as words that are difficult to understand are each marked-up to search for in a dictionary, or selectively replaced with a plainer syntax. We believe that our proxy program can be an effective tool for learners of Japanese as well as for young Japanese students. Also we believe our approach is effective for the web pages described in other languages. Our future plans include further experiment and evaluation of our program in the classroom.

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Implementing Socrates Knowledge Management System for Education and Training

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Abstract

This paper discusses implementation of knowledge ecology for organizational learning in the education and training sector. The paper describes the Socrates electronic learning environment, as an example of a knowledge ecosystem for education and training. Socrates allows even novice Web users to quickly (in a day) create teaching and training Web sites with integrated knowledge resources and Web training tools. Based on its early implementation experience, several implementation barriers are identified. Future research needs for developing and implementing organizational knowledge ecologies are discussed.

Introduction

Knowledge management is becoming an increasingly strategic issue in organizations, especially in knowledge intensive business sectors such as software, telecommunications, consulting services, and education and training. Educational and training organizations realize that to succeed in the future, they will need to take better account of their intellectual capital and organize knowledge management as a source of competitive advantage.

In the milieu of rapidly expanding information technology and knowledge work, organizations are challenged to find a framework for knowledge management that combines the human intellectual capital and digital technological processes that jointly enable knowledge work and knowledge value creation. Much of the current literature on knowledge management deals with one of these two themes. This paper develops a new conception of organizational knowledge management as "knowledge ecology". Socrates program was developed as a knowledge management system in the education and training sector, viewing classrooms as learning organizations for life long learning and creating learning communities. Knowledge management features of Socrates program are briefly described. I then discuss implementation of organizational knowledge ecologies and research needs.

The Socrates Learning Environment

The environmental context of the Socrates is business education at colleges and universities in the USA. Its design was premised on the assumption that advent of the Internet/WWWeb, e-commerce and the digital economy called for a different knowledge ecology of education - one that leveraged new information technologies, served the needs of knowledge work, and provided life-long learning communities to learners. Recognizing the strategic importance of the Internet/WWWeb, Socrates was built around a nexus of Internet based services. It allows trainers, teachers and learners to create a learning community for themselves to pursue their interests and commitments over extended periods.

Socrates represents a knowledge ecosystem that simultaneously serves an educational information service, as a Web based course development tool, and as a basis for creating electronic learning communities. It allows instructors, trainers, and students to create their own course or knowledge Web sites, and enhances what they create with embedded knowledge. This embedded knowledge is in the form of regularly updated links to numerous educational and student interest resources on the Web. Instructors, learners and other knowledge sources can interact via this program to co-create knowledge and perform educational functions typical in education. Learners can cumulate their own personal learning in affiliated Web sites.

The program is designed for Web-shy instructors and students who are allergic to programming, but still want all the benefits of WWWeb/Internet based teaching and learning. It is built on the technological core of the Internet/WWWeb, but can be executed on corporate or University intranets. This technological core is transparent to instructors, administrators, and students. That means any registered user can create courses or knowledge sites and use them for learning without knowing any programming, HTML, FTP, or telecommunications or owning and managing servers, networks, and software. The user interface is flexible to be any Internet accessible computer.

The program performs common educational functions in a networked environment. These include course administration function, knowledge management and exchange, and cumulation of knowledge for learners. Course administration includes course description in terms of its objectives, design, structure, expectations, tasks, instructor background, experience/expertise, grading scheme used, assignments, class schedule, class/lesson notes, exams etc. It assists learners to acquire relevant knowledge, perform communicative tasks, cumulate knowledge and apply it in relevant real life settings.

Knowledge agents resources are embedded in Socrates course Web sites in the form of an electronic library and links to knowledge experts. It contains over 750 hot links to corporate sites, full text articles, other publications, book reviews, business research tools, investment information, access to databases, newspapers and magazines. Learners (business students) have additional peripheral knowledge links to job and career information, resume help, entrepreneurship information, graduate studies, general learning skills, discount books and supplies and fun/humor Web sites. These links are automatically updated periodically and maintained by the program. Instructors can add additional knowledge resources of their own, when ever they want.

Networked communications occur via a bulletin board, individualized email, and community listservs. A variety of communications options and formats are available for threaded discussion, administrative notices, interaction on projects, and personal communication. The communicative network can be expanded to other courses and learning opportunities outside the school/university via the use of the Web Ring capability. This is a ring of links to similar or affiliated Web sites (The Socrates Program, 1997).

The Socrates knowledge ecology adds different types of values to the education function. For instructors it is a means for extending their knowledge base to include the rich resources of the Internet/WWW and Intranets into their teaching. Free or very low cost access to these electronic resources has the added value in some cases, of reducing the cost of educational materials. This knowledge ecology is space independent. It is free of geographical constraints of physical classrooms, permitting distance learning. It makes knowledge resources and interactive instruction available to who ever can access the Internet. For educational institutions and corporations, this offers potential cost savings. It allows training to occur when needed and when the learner is most ready for it. Learning can be in-situ at the site of the learners, allowing for mobile learning, off-time learning, and emergency learning. For learners the Socrates knowledge ecosystem provides the value of life-long and continual learning venue. Learners can accumulate their learning from courses, special topics, work projects, and integrate them into their own knowledge sites for future reference. This cumulative knowledge site is an extended virtual brain deployable at will by the learner in different jobs and locations.

Implementation Issues

In 1997 over 170 Socrates site licenses were issued in 20 countries. These sites are being studied to understand further development issues and implementation barriers. Based on early feed back from these trial sites and the author's own experiences in using the system, several initial research needs and generic barriers to adoption of knowledge ecosystems for education/training are identified below. The implementation of knowledge ecologies poses technological, human, social and institutional challenges that we are only beginning to understand.

1. Technological Problems. Knowledge ecology represents the convergence of several disparate but linked technologies. Successful knowledge ecology for education/training involve instructional design, multimedia technology, computers and telecommunications technologies, content area expertise, and business/industry linkages. Integrating these technologies into large-scale systems is a complex and difficult task. To make matters worse many of these component technologies are facing rapid internal changes. More capabilities are continually becoming available. Designers must learn the new capabilities and integrate them into their systems on the fly. New capabilities are not always compatible with old ones, sometimes necessitating wholesale redesign of the entire ecosystem, and increasing the cost of implementation.

2. Human Problems. Implementing knowledge ecosystems requires dealing with emotional responses to artificial knowledge agents. Historically, knowledge and intelligence have been the distinguishing characteristic of human beings. Now computers are able to take over some of the routine and even expert functions of knowledge work. In some areas computers excel over human capabilities. The conflict of human versus computer intelligence is epitomized in such cultural icons as the chess contests between grandmasters and Deep Blue (followed by over 300 million people worldwide). This conflict is an intensely emotional matter. Like other emotional issues it remains largely suppressed in organizations. However, the conflict and deep emotional resistance among users and learners can sabotage implementation of knowledge ecologies, or at least reduce their effectiveness.

A related problem is the very natural human fear that computerized knowledge ecologies come dangerously close to replacing humans in knowledge work. In the education industry this fear is particularly palpable. While there are some innovators who embrace educational technologies such as the Internet/WWWeb, a large number of faculty regard these technologies with deep suspicion. The administrative and institutional demands for productivity in colleges and universities in recent years make the threat more real and immediate.

3. Institutional Problems. Organizational resistance to change is encountered when implementing any new technology. This resistance is more pronounced in implementing knowledge ecologies because the technologies involved are holistic and all-encompassing. They affect the whole organization, all functions and tasks, and performance outcomes at many levels. These technologies reconfigure access to knowledge and consequently power equations within the organization. They change career prospects and earning potential of members. They require organizational members to be retrained. They involve changes in structures and systems, and installation of new equipment. Such organizational changes provoke upheaval and conflicts.

Organizational change problems are compounded by the lack of comprehension of what knowledge ecologies represent. In some senses, knowledge ecology is an extended virtual brain of the organization. The knowledge function and access of this ecology extends well beyond the cognitive capacity of individual humans or even departments and divisions. It represents a new form of organized complexity that many managers and workers find incomprehensible. It falls outside the collective cognitive map of the organization.

4. Creating Electronic Learning Community. One important shortcoming in using electronic knowledge management systems for educational purposes is the lack of interactivity. True community implies high degree of interactivity, multiple mechanisms for interaction and a natural order of communication within the community. Creating learning communities requires improving interactivity of all types. Users have suggested a variety of mechanisms that can make interactions go beyond the classroom to include outside professional experts, international voices, ideologically diverse voices, and mentoring resources. The use of email, listservs, Usenet groups, threaded bulletin boards, and other electronic communications options need to be judiciously balanced. Interactivity also means integrating

multimedia resources into the knowledge ecology. However incorporating these interactivity and multimedia features into knowledge management systems is limited by the quality of "access" that users have. In educational environments the quality of access varies tremendously, and it is easy to provide resources (e.g. video and audio streaming) that users simply cannot download.

Research Issues

Three important research questions need to be addressed for further development of knowledge ecologies. These pertain to the roles to be played by different participants, cost/benefits of such systems, and knowledge quality management

1. Work Roles Within Knowledge Ecosystems. It is apparent from the above discussion that that knowledge creation, work interaction and performance in knowledge ecosystems are significantly different from the conventional use of knowledge as it is currently organized in most organizations. For business educators knowledge ecosystems pose a challenging question about pedagogical roles. Learning in such systems is collective network activity. It requires a community learning process. One of the most difficult thing about effective Internet based teaching for faculty, is that it requires them to play a very different role than the conventional one of content expert and mentor. The Internet displaces and fragments the concept of expertise. Expertise - if it is defined as possessing information, can be resident in places other than the teacher. It can be embedded in transaction systems, in Web Sites, in colleagues, in students.

In knowledge ecosystems the role of the teacher is more that of a co-learner. Because information is expanding at such a Promethean pace, no single person can remain an expert on any subject for very long. This fact becomes apparent very quickly to both students and teachers in the Internet environment. This is empowering for students as they realize that there is possibility of reaching expertise beyond that of the instructor. It is also distressing for faculty as they realize the very real and open limitations of their expertise. To remain effective instructors and students need to forge new relationships of mutual learning through discourse and critique.

Extrapolating this concern about roles to non-educational organizations, I surmise a need for rethinking all organizational roles in knowledge organizations. The conventional categories of functional areas (finance, marketing, accounting, operations, etc.) or hierarchical delineations, or even professional work categories do not fit knowledge work. Knowledge work transcends function, structure and professional expertise due to its intensely networked and integrated nature. In companies engaged in knowledge management new titles are appearing such as, Chief Learning Officer, Chief Information Officer, Chief Knowledge Officer, Webmaster, Chief Technology Officer. Similarly new departmental configurations such as, Client Services (combination of sales, marketing, technical support, billing, etc.) or Knowledge Centers (combination of library, product expert network, databases, public relations, communications, etc.) are emerging to reflect the integrative nature of knowledge work. The efficacy of these titles and new division of labor needs to be examined and contingencies for their application need to be identified.

2. Cost/Benefit Analysis of Knowledge Ecosystems. The willingness to create knowledge ecosystems in education depends on how college/ school administrators understand their costs and benefits. Unfortunately very little is known about this aspect of knowledge ecosystems. Even corporations who have pioneered these systems have done so more on faith than on facts. In a preliminary way we can identify costs of such systems to include hardware & software investments, personnel training, knowledge conversion, Internet access equipment by learners/users, information search time to do quality control, IT infrastructure creation and maintenance. Benefits of knowledge ecosystems include, access to the rich information resources of the WWW/Internet/Intranets, Web publishing opportunity for learners and instructors, savings in time due to electronic communications, savings on paper, transportation and space requirements. A systematic study of these costs/benefits is sorely lacking. However, the explosion of Web based training systems being witnessed currently is significantly driven by the rationale of cost savings (Meister, 1997).

3. Knowledge Quality Management. Electronic knowledge resources particularly the Internet/WWW are notorious for quality problems. Lack of standards, lack of controllability, high dependence on vendors for quality control, lack of universal access all contribute to high variance in information quality. There is no guarantee of truthfulness of information and there is a high noise to

information ratio on public information networks. These problems are partly a function of the newness of the medium. As the Internet and its use mature some of these problems will be resolved through standards, surveillance mechanisms, and regulations.

A related problem is that electronic media is excellent for some types of knowledge and certain types of knowledge work, but poorly suited for other types of knowledge work. It is best for storing and transmitting large volumes of codifiable information. It is poorly suited for capturing tacit, social, and emotional knowledge, which are often difficult to articulate and codify. Knowledge work that has high emotional or tacit knowledge content may not be feasible in the kinds of knowledge ecologies discussed in this paper.

In Lieu of a Conclusion

This exploratory study introduced the concept of knowledge ecology as a frame for understanding the organizational learning and knowledge work. This framework offers a preliminary yet valuable theoretical lens for knowledge management. There is little that can be definitively concluded from this initial analysis, except to point out the lucrative theoretical and practical potential of using ecological theories for understanding organizational knowledge management. Natural ecosystems are complex knowledge systems. They are versatile enough to handle biological, genetic, physical, geological, atmospheric and other types of information in coherent, cyclical, performances. Ecosystem theories and metaphors are powerful, highly mathematized, analytical tools that could be valuable for organizational system analysis and design.

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Electronic Commerce - European Public Administration Context

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Abstract: Recent developments in Europe following the Treaty of Maastricht are leading towards the practical implementation of a single market for trade and commerce throughout the states which make up the European Community. The set of 15 states currently members of the Community are striving to create the conditions and regulatory framework necessary to allow for a truly open market including the important area of national and local Government Procurement. This paper presents a view of the current research and development activity in Electronic Commerce focusing particularly on the needs of local and national Government.

Electronic Commerce in Europe

The elements of the technology needed for Electronic Commerce have been more or less available for a number of years but it is only recently that they have begun to come together into recognisable systems that implement what we now know as Electronic Commerce.

These developments have come almost 20 years after the introduction of personal computers with modems. The mobile phone was a rarity a decade ago but is now a fashion item rather like a wristwatch.. The explosive growth in the internet and the world wide web has produced for the first time the necessary conditions for the development of electronic commerce. The internet has been the key factor in allowing the connection of huge numbers of computers and the web has provided the means of viewing and distributing the mass of data accumulating in servers around the world.

Before we consider the nature of E-Commerce and its impact we should first consider the driving forces within commerce itself that are leading the growth in demand for E-Commerce applications. It is usually the case that every generation believes that its work and ideas are new and essentially unique. Whilst this is true in a large number of cases the world of commerce had already thought of virtually all ways of selling its goods to customers well before the start of the 20th Century and that includes most of the ways currently being implemented as E-Commerce. Of course the new work has been in the development of secure electronic transfer of fund and other technical areas but the point remains that the commercial techniques for selling goods and services are essentially the same whether or not it is done electronically.

The development of E-Commerce has brought a return to the notion that transactions can be conducted at a distance with payment and delivery being organised remotely as well. In some cases even delivery is by electronic means as for example in music and software.

Forecasts of growth in revenue from these activities are probably going to underestimate the real value of business but the following chart is based on a recent survey of US companies currently implementing E-Commerce plans.

Electronic Procurement - Governmental E-Commerce

The current push in Europe for ever more efficient public bodies is leading to the adoption of electronic means of communication between the various actors involved in public procurement The scope and complexity of these markets is growing at a fast rate for two reasons: the liberalisation of trade at national, European and world-wide levels; markets are being opened up in response to the

European Single Market and to the Government Agreement on Tariffs and Trade (GATT); the increasing fragmentation of large organisations, particularly in the public sector, and an increasing tendency for them to divide into purchasers and suppliers, with competition among suppliers. In the United Kingdom, government legislation enforces competition in public services.

It is estimated that about 160,000 procuring entities make about 200 calls for tenders each day in Europe. This is expected to grow five fold over the next few years. The ability of administrations, procuring entities and suppliers to meet the demands of increasing international competition is severely hampered by limitations in the means currently available to initiate, develop, manage and respond to projects which are subjected to competitive processes. Competitiveness in its turn depends on efficient procurement systems and efficient information flows in these systems, and there are actual and potential hindrances to the achievement of these.

Developments in Governmental E-Commerce

The last few years have seen the development of many systems of e-commerce mostly aimed at the commerce to consumer pathway. The projects outlined in this paper are concerned with the relationship between government bodies such as local authorities and the citizen. They cover areas such as benefit payment and entitlement, public information and opportunities for the supply of goods works and services.

Current developments in the procurement field are likely to add substantially to the volume of tenders administered through the EC procurement regime. Many of the new tenders are in fields particularly suited to electronic tendering. Further developments indicate a requirement for tendering systems to be able to deal effectively with both in-house tenders, and to integrate with teleworking systems.

A major factor in the development of E-Commerce systems, especially for Government is that of social exclusion. If large parts of the interaction between the public and their governments will be conducted by electronic means, where does that leave a member of the public who does not have access to affordable communications and computing power? The question of exclusion is one that will require a substantial sociological programme to address it. There are also the regulatory aspects of E-Commerce to consider. The position in Europe regarding encryption is unclear and will not be resolved for some time. Even with this problem companies are forging ahead with E-Commerce applications which take credit card details as payment and which use various forms of encryption over the internet. These developments will force Governments to consider the regulatory aspects more quickly than they would wish. Another issue is the extent to which life will become dependent on the use of smart cards and other E-Commerce technology. Currently business is conducted by many means including physically travelling to a shop and buying goods with cash or credit/debit cards. The credit agencies currently provide a service to the business community by maintaining lists of credit worthiness that has a level of granularity in the UK of the address. This means that one person at a particular address who has a poor payment record, for example, will effectively be the determiner of credit worthiness. This will affect everyone living at the same address. In the UK there are already problems with parents being affected by their children's poor payment record and vice-versa.

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NASA's LEARNING TECHNOLOGIES PROJECT

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Abstract: The Learning Technologies Project is part of a government initiative within NASA's High Performance Computing and Communications (HPCC) program whose mission is to accelerate the development, application, and transfer of high-performance technologies to the US engineering and science communities. The Learning Technologies Project seeks to increase public access to scientific databases, develop new applications and pilot programs for using science data, and create new curriculum projects and tools for K-12 education - all via the Internet.

The Learning Technologies Project (LTP) is one NASA's many educational programs that stem from NASA's plan for educational excellence to "involve the educational community in our endeavors, to inspire America's students, create learning opportunities, and enlighten inquisitive minds". The LTP K-12 program is responsible for developing affordable innovative K-12 projects, technologies, and applications that can be widely disseminated to the educational community. The program uses NASA science activities and Internet based technology to inspire students to excel in science, math and engineering and to undertake high technology careers. There are five branches of the LTP program: The K-12 Education Outreach Centers, The K-14 Aeronautics Projects, The Remote Sensing Public Access Center (RSPAC), the Digital Library Technology (DLT) Projects, and Special Projects. This short paper focuses on the LTP K-12 Education Outreach Centers.

The NASA LTP K-12 Education Outreach Centers develop projects and applications that are widely disseminated throughout the educational community. Resources include images, mission data and lesson modules. Several interactive projects focus on special aspects of NASA and provide email with NASA experts, WebChats with NASA employees, and collaborative projects. Others resources include information about getting connected to the Internet, integrating the Internet into the classroom, low cost Internet access, and the organization and creation of Internet-based lessons. Selected example projects by name include Quest, the Learning Technologies Channel, Sharing NASA, the Internet Video Series, Telescopes in Education, ILIAD, SIMON, the NASA Qwhiz, Off to a Flying Start, and FoilSim.

Quest is home to a family of online resources such as the Learning Technologies Channel and Sharing NASA. The Learning Technologies Channel is an Internet location (http://quest.arc.nasa.gov/ltc) where teachers and students participate in online courses and remotely attend NASA workshops and seminars. Using the Web and RealMedia technology, teachers participate in live lectures, interactive workshops, and virtual field trips to remote locations. Sharing NASA focuses on the people of NASA that live and breathe the space program every day. Over the Internet, these people come alive in K-12 classrooms as students participate in WebChats with NASA volunteers, ask NASA experts questions, and other online activities. Sharing NASA helps teachers integrate science and technology issues into the classroom and also offers many opportunities to enhance reading, writing and creative expression. The Quest project has produced a series of videos to help teachers, administrators and others bring the Internet into the classroom. Videos include **Global Quest: The Internet in the Classroom**, **Connecting to the Future**, and **Global Quest II: Teaching with the Internet**. Quest can be located on the Internet at http://quest.arc.nasa.gov

Telescopes in Education is an opportunity to bring a remotely controlled telescope and charge-coupled device (CCD) camera to students around the world in a real-time, hands-on, interactive environment. TIE uses a science grade twenty-four inch reflecting telescope located at the Mount Wilson Observatory, high above the LA basin in the San Gabriel Mountains of Southern California. Students remotely operate the telescope in their classrooms and observe galaxies, nebulae, variable stars, eclipsing binaries and other astral phenomena. TIE can be located on the Internet at http://tie.jpl.nasa.gov/

The LTP offers several software tools to find and manipulate Web-based information. ILIAD is an email agent that searches the Web while you're offline. Users send the ILIAD server an email message that contains a query. The ILIAD agents search the Web, analyze the documents and mail back the most relevant documents to the user. ILIAD combines state-of-the-art Internet access with the lowest common denominator computer equipment and software. This tool has been adopted by the blind community as an alternative to GUI-based Web searching. SIMON incorporates the ILIAD search agent and adds the ability to edit and classify documents and automatically generate Web lessons. SIMON has the added benefit of providing full Internet access to a school LAN with a single phone line and a PPP Internet account. The NASA Qwhiz is an interactive, real-time, multi-player Web challenge game. Players at two schools compete to complete a Qwhiz preloaded with NASA information. Teachers can use a Qwhiz from the Qwhiz Library or make one of their own. Students can also create Qwhiz material to test each other on class material. The Qwhiz itself is a reinforcement tool for material the teacher has presented previously in class. You can access these LTP software tools at http://prime.jsc.nasa.gov/

Off to a Flying Start is an online project for K-2 students that communicates the excitement of aeronautics. The project generally takes place between October 1 and May 31 and consists of three modules: Introduction to Flight, where students learn basic principles related to airplane design and the theory of flight; Flying the Falcon Flyer, which allows students to build and fly their own gliders; and Experimental Design, which builds on the results obtained with the Falcon Flyers. Students learn to use scientific reasoning to design and construct their own planes while they investigate and share results. They discuss how and why airplanes fly, identify the parts of a plane, and collect and graph data. More information about this project can be found at http://k12unix.larc.nasa.gov/flyingstart

FoilSim is an educational software package designed to instruct students in the basics of aerodynamics. The software contains two main parts, a baseball pitch and a wing-airflow simulator. The software includes lessons which prompt students to engage in problem solving and discovery. The software was created to satisfy an objective to cultivate a more thorough understanding of the research being done at NASA while also filling a critical need for additional intuitive tools that supplement and enhance math and science curricula. Visit the FoilSim site at http://www.lerc.nasa.gov/WWW/K-12/aerosim/

These and many other LTP resources are available for use in schools and are for the most part free. Resources are available in the disciplines of aeronautics, aquatics, astronomy, astrophysics, career planning, environmental science, history, mathematics, science, engineering, space science, volcanology and weather mapping. All of NASA's online information can be use to create classroom content by using up-to-the-minute mission information and images, archived information, lesson plans and teacher tested activities. These support materials can be used to enhance established curriculum or create new collaborative projects. To participate in any of these projects visit the LTP Homepage at http://learn.ivv.nasa.gov and join us online as we share the power and excitement of the work at NASA with our children..

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Technology Application and Accountability Are Here: Are Elementary Schools Ready?

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Abstract

A short review of steps being taken by Texas educators to meet the President's challenge to produce technologically literate individuals.

In 1996, President Clinton launched a national mission to make every young person technologically literate by the dawn of the 21st century. In an attempt to reach this goal Trotter [Trotter 1998] reported that all states and many school districts have technology plans; however, the quality of these plans varies widely. The results of scientific research by Jones and Paolucci [Jones & Paolucci 1998] determined that differences in learning, attributed to the use of computers to improve and stimulate learning, were inconclusive. Many current applications of technology reinforce the everlasting problems of educators to find a balance between the teaching of skills and the basic teaching of knowledge.

States and legislatures are demanding that teachers attain and use technological competencies. Dare County in North Carolina requires teachers to take 20 additional hours of technology training each year if they want to qualify for merit pay [Trotter 1997]. In California, legislators recently passed a law requiring that, after January 1, 2000, a teaching credential will be contingent on "demonstration of basic competency in the use of computers in the classroom". To receive a permanent credential, teachers will have to study advanced based technology [Trotter 1997]. Beginning in the spring of 1999, veteran teachers in North Carolina renewing their licenses will be required to earn 3 to 5 credits in technology. However, most schools still do not make technology competence a formal part of performance evaluation.

To meet the challenge, Texas has adopted standards to assure the development of technology literate individuals who possess the knowledge and skills to solve problems, make decisions, and become lifelong learners as they mature in a society driven and dependent on emerging technologies. These curriculum components were adopted by the State Board of Education in 1997 and are known as the Texas Essential Knowledge and Skills (TEKS). They consist of basic understandings, knowledge and skills as well as performance descriptions required of K-12 students. These replace the Essential Elements adopted by the State Board of Education in 1984 in response to legislation passed in 1981. Teachers are expected to integrate these requirements into the curriculum during the 1998-1999 school year and will be held accountable for student performance on the Texas Assessment of Academic Skills (TAAS) which is the current standardized test used by the state to evaluate student achievement for graduation from high school. The primary measure of the effectiveness of the program will be evaluated by student outcomes.

A modified version of the state requirements for grades K-12 follows:

Technology Literacy Checklist

Can Grades K-12:

1. Start and exit a program; create, name and save files?
2. Use input devices (mouse, keyboard, disk drive, modem, recorder, scanner, etc.)?
3. Use design principles (fonts, color, white space, graphics) that are appropriate for a defined audience?

4. Delineate and make necessary adjustments regarding compatibility issues including, but not limited to, digital file formats and cross platform connectivity?
5. Use proper keyboarding techniques such as hand and body position and smooth and rhythmic keystroke patterns?
6. Demonstrate appropriate speed on short timed typing exercises?
7. Use appropriate electronic search strategies (including keyword and Boolean search strategies)?
8. Create technology assessment tools to monitor progress of projects such as checklists, timelines, or rubrics?
9. Understand the relevancy of technology in future careers, life-long learning and daily living?
10. Plan, create, and edit a document with a word processor using readable fonts, alignment, page setup, tabs and ruler settings?
11. Create and edit spreadsheets using all data types, formulas and functions, and chart information?
12. Plan, create, and edit databases by defining fields, entering data, and designing layouts appropriate for reporting?
13. Use interactive virtual environments such as virtual reality or simulations?
14. Use telecommunication tools for publishing such as Internet browsers, video conferencing or distance learning?
15. Use programs such as desktop publishing, digital graphic and animation, multimedia, video technology, and/or web mastering?

This latest mandate is forcing school districts, schools, and personnel to review the current status of their programs and develop ways to ascertain on-the-edge instruction for all students in the many areas of technology included in the K-12th grades TEKS requirements.

In view of these educational changes, Schools of Education are being forced to re-evaluate their teacher education programs. Charp [Charp 1994] reported that teacher education programs requiring computer literacy for all students have increased, although slowly. Subject matter is being redesigned to integrate technology in both methods and foundation courses. Guidelines developed by the International Society for Technology (ISTE) are being used by many institutions to integrate technology in the development and/or revision of curriculum. Faculty involved in teacher preparation programs are being forced to assume that if pre-service teachers are to integrate technology during their field work, student teaching, and initial classroom experiences they, too must be prepared to assist those who study in their groups. In the near future, the success or failure of the teacher preparation programs will be determined by the number of pre-service teachers that successfully pass a certification test. Too many failures in an area will result in the elimination of that preparation program.

A study is being conducted by St. Mary's to evaluate the skills and attitudes of the teachers in mentoring schools in San Antonio, students completing the teacher education program, and those just entering the program. Initial reviews of responses present a dismal picture especially in light of the $500 million technology investment Texas has made since 1992 [Natale 1997]. The TEKS implementation and future test results will further emphasize to teachers the need for their active cooperation in doing their part to enable their students to enter the next century prepared to cope with and successfully achieve in the rapidly progressing world. The state of Texas has developed and is implementing formal standards that teacher education programs can build upon. The Texas Education Agency has provided resources to schools to obtain equipment, programs and development monies. Now it is up to each individual to participate and achieve to their highest potential.

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Together Through Technology

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Abstract: Integration of internet resources into curriculum at all levels, K-12, is supported by collaboration between one small Texas school district (AISD), a university professional development center (CCPDC) at Texas Woman's University (TWU), the Corporation for Public Broadcasting (CPB) and the National Council for Accreditation of Teacher Education (NCATE). The content of this ongoing collaborative project is curriculum support from the internet, but the processes of collaboration and utilization of technology are equally important. The processes are inherent in goal achievement and are pursued in each of the seven goals examined in this paper.

The Setting

This collaborative effort links multiple entities toward the common goal of using the internet to support the delivery of curriculum. The Community Collaborative Professional Development Center (CCPDC) at Texas Woman's University (TWU) encompasses eleven school districts in North Texas and other partners from business, education agencies, and community organizations. The CCPDC districts include two urban districts, three suburban districts, and six rural districts.

One of the small rural districts is the central focus of this effort. Aubrey Independent School District (AISD) implemented utilization of the internet by every teacher K-12 in the spring of 1998. Further, they established links with a partner district in El Paso, Ysleta ISD, in order to share their curriculum development with an urban district with high minority enrollment. This effort was supported by a Next Step grant co-sponsored by the Corporation for Public Broadcasting (CPB) and the National Council for Accreditation of Teacher Education (NCATE). The TWU/AISD team is one of two teams selected in Texas. Additional support for infrastructure was received through a state grant available to districts with fewer than 1000 students.

This project implemented an all-level effort for training and utilization of the internet in all classrooms in Aubrey ISD. It provided for outreach that includes the sharing of the experiences and products within the district, with collaborating districts in the TWU Professional Development Program, with the University classes and professors, via Internet with Ysleta ISD peer teachers, and eventually with Summit Teams of the Corporation of Public Broadcasting (CPB).

The Participants

Aubrey Independent School District (AISD) is a small rural North Texas district enrolling 905 students in its elementary, middle, and high schools. Aubrey itself has approximately 1000 residents and is surrounded by an agricultural area which raises quarter horses, cattle, and peanuts.

The school district is the largest employer in town. Thirty percent of the students are designated as at-risk based on low SES. Nevertheless, Aubrey ISD is a Recognized District based on state testing. Of the 1044 Texas school districts, 320 earned this ranking. Although AISD is limited in resources, it is successful in staff development,

utilization of technology, and student academic performance. Every teacher has the internet available in the classroom and was responsible for developing appropriate curriculum utilizing these resources.

Over the past five years Aubrey ISD has collaborated with Texas Woman's University (TWU) in the development of the new teacher education program. Primarily these efforts have focused on improving classroom instruction in the field settings. With support from TWU, a series of staff development sessions were implemented for AISD and other rural districts. An important additional benefit of this effort has been the effective modeling and mentoring provided by these trained teachers for TWU preservice teachers. Now this same district is using the internet to enhance the curriculum at all levels.

During the spring of 1998 all AISD teachers were trained to develop lessons using Internet for their various grade levels or content areas. The training was planned and delivered in February by six AISD lead teachers representing the various campus levels. These lead teachers were trained at the Educational Service Center, Region XI, in Ft. Worth, Texas, and continue to support the teachers on their respective campuses.

Ysleta Independent School District (YISD) is a large urban district with 56 campuses. It is on the far western border of Texas. It is 600 miles from the capital of Texas at Austin, and is the same distance from Los Angeles as it is from Houston. It is desert country, at the south edge of the Rocky Mountains. It has a strong sense of the cultures which make it unique: Mexican, Indian, Spanish and European. It began as a very small rural district at the outskirts of El Paso County. Today, it is a major educational organization in the El Paso metropolitan area.

The enrollment of YISD is 75% minority. Of the 56 school campuses, 13 became recognized in 1996. This was the highest percentage of any district in the area. As an urban district, it ranks higher than any other of the eight urban districts in Texas.

The Program Coordinator of the Magnet High School coordinates the partnership program implementation and evaluation in YISD. A network of elementary, middle, and high school teachers in El Paso were identified to serve as partners to the AISD cadre of teachers for implementation of the WWW based prototype lessons.

The Corporation for Public Broadcasting (CPB) in collaboration with the *National Council for Accreditation of Teacher Education (NCATE)* has sponsored a series of symposia nationwide designed to support the integrating of technology into education. These Ernest L. Boyer Summits for Educators were held in Pittsburgh, Nashville, Los Angeles, and Dallas. Selected professors were invited to bring teams including public school personnel to the symposia. The teams attending were encouraged to seek grants to support these efforts in expanding use of technology in education in their home settings.

Texas Woman's University included representatives of two of its collaborating rural districts in the Fourth Symposium in Dallas. The Technology Director of Aubrey ISD was ready to support comprehensive expanded use of the internet throughout the district. So the project was designed to train and support teachers at all levels in the district and eventually, to share developed curriculum electronically with teachers in a partner district with quite different characteristics. This urban high minority district in a different Texas climate area offers a unique opportunity for keypal exchanges.

This effort was timely and possible due to (a) the size of the Aubrey district; (b) its advanced status in technology; (c) its history of collaboration; (d) its support of staff development to reach district goals, and; (e) the support for technology provided by the AISD Board. The AISD Technology Coordinator at that time projected a 4 to 1 ratio of computers to students, a WAN and Internet access in all classrooms by January of 1998, and projected links to TWU, the CCPDC, and the CPB.

It was an honor to be invited to the Dallas Summit sponsored by CPB and NCATE and to be one of two Texas university teams funded. Nationally, more than 100 teams have participated in the series of four summits. All these teams are focusing on integrating technology into the curriculum. In each case the collaboration on the team, and between the entities they represent supports the belief that both schools and universities can change, and will.

The CCPDC Collaborative includes two urban districts (Dallas and Ft. Worth), three suburban districts (Denton, Keller, Lewisville), and five rural districts (Aubrey, Lake Dallas, Little Elm, Pilot Point, and Sanger). Each district in the CCPDC collaborative has unique characteristics, and the CCPDC design provides preservice teachers experience in multiple types of settings including rural, suburban, and urban. In addition to the eleven school districts, CCPDC partners include the Regional Education Service Center XI, Dallas County Community College District, the Texas Parent Teachers Association, Community in Schools, and International Business Machines (IBM).

An Advisory Board representative of the various partners sets policies for the collaborative operations. The CCPDC Director is responsible to the Advisory Board and to the Dean of the College of Education and Human Ecology within the Texas Woman's University. Eleven university professors serve as CCPDC University Liaisons linking the university to the various participating districts. The CCPDC program was first funded experimentally in the fall of 1996 and students have been phased into this program over the past four semesters. Beginning fall1998 all incoming undergraduate students in teacher education complete their preservice training in this program.

Collaborative Activities

The content of this project is curriculum support from the Internet, but the processes of collaboration and utilization of technology are equally important. The processes are inherent in goal achievement and are pursued in each of the seven goals:

1. To teach technology within a meaningful context.
2. To support distance learning with use of the internet.
3. To design, implement and evaluate collaboratively the training of teachers on use of the internet.
4. To design curriculum collaboratively by grade level and content area groups using internet resources.
5. To support collaboration through developing and maintaining web sites linking participants.
6. To support changes in higher education through collaboration and modeling.
7. To disseminate and extend learnings through the developed web sites, in reports and publications, and at conferences.

Goal 1: Technology within a Meaningful Context

This goal of this project is to USE technology, not to TEACH it. The reality of the Information Age is the need to have access to information, organize it, and apply it to our problems and goals. At each level professional educators must model roles as well as creating student challenges to support their development as information managers and users Examples inherent in this project are:

- Internet training for a cadre of teachers who will support their respective colleagues in acquiring the necessary skills to navigate the internet.
- Teachers locating internet resources that enrich content, stimulate collaborative learning, and inspire students.
- Teachers developing lesson plans which include the integration of these resources.
- Middle school students developing web pages for each of the district campuses through which these lessons will be shared.
- Use of the developed project web page to support collaboration between teachers, both within the district, across the state, and at the university.
- Expand the learning of preservice teachers as well as university professors in the area of using the internet as a lesson resource. The availability of these resources on the AISD, CCPDC, and TWU web sites also supports dissemination and encourages reflective interaction between professional educators locally as well as nationally.

Goal 2: Distance Learning Through the Use of the Internet

Access to the internet in every classroom creates a "classroom without walls" for every student and teacher. Projects can be designed, implemented, and evaluated collaboratively with others at great distance to the classroom. Unique perspectives and fresh ideas can be explored and extended. Learning opportunities can be shared and utilized. Parents and community members can learn in much more detail the curriculum, student expectations, and learner outcomes of the school. The fascination of Internet can be focused on reaching effective solutions of common problems. This collaborative effort provides a framework for cross-cultural exchanges between teachers in contrasting districts and possibly for their students. The sharing of resources is expedited by technology, and the storage and transfer of plans continues to be expedited with technology.

Goal 3: Using the Internet for Curriculum Development Training for Teachers

The first step in teacher training was a series of voluntary after school sessions for technology novices in February 1998. These sessions provided basic experience in connectivity including use of a web browser, bookmarks, and accessing some valuable educational sites. This orientation was followed by two inservice days. The group was divided and rotated. One day centered on lesson development and the other on analysis of the appropriate Texas Essential Knowledge and Skills (TEKS) for individual grade levels and content areas. It was decided that the first round of lessons developed using the internet as a vital resource would reflect a direct instruction model. The third training period provided opportunity for the teachers to develop lessons in their own classrooms with the lead team available in their building on that day for specific help and encouragement. Each teacher was expected to develop, teach, and evaluate at least one lesson during the spring semester. The lead teachers facilitated the various teacher teams as they developed their lessons. Because of the state-wide testing program in early March, these lessons were not implemented in the classrooms until April. Some peer testing and evaluation was explored, but these were primarily delayed until the Fall of 1998.

Following the teacher training on integrating the internet into the curriculum, the participants were given the opportunity to evaluate the sessions. The criteria for evaluation included commenting on: significant knowledge gained; computer access; objectives and instructions and; suggestions for future sessions. In examining significant knowledge gained by the teachers, the comments fell into three different categories: (a) basic navigation of the internet; (b) support for teaching; and (c) vocabulary development. This evaluation shows that the sessions was supportive for this group of teachers, many of whom could be considered to be novices to using the internet for instructional purposes. Learning how to explore the internet, finding actual sites which are useful for your specific content area and grade level, and gaining the necessary vocabulary which allows you to articulate the use of this technology are all necessary components to becoming a technologically literate teacher. The evaluations also indicated successful training sessions in the areas of computer access and objectives and instructions. 90% of all teachers trained (n=30) felt that they had adequate time on and access to computers. 100% of the teachers in attendance felt that the objectives and instructions were clear enough to allow them to successfully complete their final product. Suggestions for future sessions included more hands-on training similar to these sessions on integration of technology into the curriculum. Additionally, a small percentage of teachers (3%) would have liked to have brought a previously developed lesson plan with them to the training session. Many in attendance were in agreement that time spent during the training session could have been focused on infusing that lesson with internet resources and information rather than developing a lesson.

Plans for extension training include a Summer Institute which will further explore the integration of the internet into the curriculum. Exploration of student on-line projects and the development of web-quests will be addressed. Additional topics for this Summer Institute include: (a) Windows 98; (b) presentation software; and (c) The Texas Library Connection.

Goal 4: Designing Curriculum Using Internet Resources

Curriculum planning was based on new state standards, the Texas Essential Knowledge and Skills (TEKS). Revisions recognized these new state standards, the testing program for Texas called the Texas Assessment of

Academic Skills (TAAS), and the contributions available through internet resources. Each lesson developed using the internet was implemented and evaluated by the instructor. The main goal was to use the Internet as a tool not as the focus of the lesson. Next, the lead teacher team selected the best for each grade level in elementary school, and each content area for middle and high school. Those lessons chosen were implemented and evaluated by a peer teacher. The next classroom evaluation will come from teachers in Ysleta who use them in the fall of 1998.

Goal 5: Establishing Web Pages and Links.

AISD, YISD, CCPDC, TWU, CPB, NCATE, and the research professors are to be linked. At this writing, the various entities are in different stages of development. It is a collaborative work-in-progress. AISD middle school students created the WEB pages for each of the campuses and the district. University professors created the CCPDC web pages, the Next Step Grant project web pages, as well as their own. A web site is in place which will support the ongoing collaboration and development of lessons between these two districts. This page is located at http://venus.twu.edu/~f_snider/cpb2.html.

Goal 6: Changing Higher Education Through Collaboration and Modeling.

Changing higher education remains a significant challenge. Within the university, an interesting phenomenon can be observed. It parallels the home experience in which the technically savvy youngster draws parents into use of the computer for some meaningful purpose or coaches the parent through a beginning effort. At the university, as students advance in educational technology seminars and in telementoring among themselves, they bring to all their education classes new questions and new expectations. They expect to communicate interactively by Email, they want to submit work electronically, they question time spent on mundane activities or traditional library activities, they promote responsible and effective collaborative projects, they seek performance based assessments, and they demand justified flexibility in attaining objectives. Few of these are new, but technology adds to their argument and their urgency.

The faculty subculture as a whole exhibits a slow shift toward thoughtful examination of the meaning of technology advances to their respective specialties. Some well-established faculty provide inspiring models of web based delivery of instruction, outreach to new students, and collaborative development and sharing among interested faculty. New faculty frequently bring enthusiasm and great energy to their teaching endeavors. They model creative delivery of instruction using a variety of technology tools, and they question traditional routines that may be time consuming and inefficient. The public display of course syllabi and course materials by these talented young people challenges some of the senior faculty. But like the youngster teaching the parent, these new professors guide the senior ones.

A key advantage in the CCPDC program has been the systematic integration of technology into the teacher education program. Professors of educational technology have taken the lead in presenting a model of instructional delivery that places the syllabi, course materials, evaluation instruments, deadlines, and resources on the WEB.

The TWU preservice teachers participate in field settings for two semesters as interns prior to becoming residents in a third placement. The technology sequence over the three semesters of field experience encompasses connectivity, productivity, and integration. Students become aware of the technology expectations for certified Texas teachers and frequently begin their first job better prepared than the experienced teachers.

As district liaisons, the educational technology professors also encourage the use of the web pages to support colloquy with mentor teachers, and to provide reflective responses to interns and resident student teachers. Professors, like teachers, evidence varying interest in using technology and willingness to try new approaches. This project is an additional example of the systematic integration of technology which provides an additional avenue for collaboration between the university and the school sites and ultimately stimulate an ongoing change process.

Goal 7: Disseminating Learnings

This content of this project is curriculum, but the processes of collaboration and utilization of technology are equally important. The collaboration of teachers across grade levels and content areas extends their professional development within the district settings but, their active collaboration with liaisons and other professors also enhances teacher education in the university setting. This collaborative effort provides a framework for cross-cultural exchanges between teachers in contrasting districts and possibly for their students. The sharing of resources is expedited by technology, and the storage and transfer of plans continues to be expedited with technology.

University seminar presentations by the AISD mentor teachers expand the learning of preservice teachers as well as university professors in the area of using Internet as a lesson resource. The availability of these resources on the AISD, CCPDC, and TWU web sites also supports dissemination and encourages reflective interaction between professional educators locally as well as nationally.

Summary

Integration of the internet into curriculum at all levels, K-12, is supported by collaboration between one small Texas school district (AISD), a university professional development center (CCPDC at TWU), the Corporation for Public Broadcasting (CPB) and the National Council for Accreditation of Teacher Education (NCATE). This ongoing effort is available to others through the web sites of these respective entities.

Acknowledgments

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Faculty Development, Learner Support and Evaluation in ALN Programs

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Abstract: The University of Central Florida has formally recognized distributed learning as a strategic direction to increase access to educational opportunities for students within our service area and beyond. The university has chosen to employ asynchronous learning networks (ALN) as a primary approach to address the challenges of a rapidly-growing student population, a shortage of classroom space, and the need to maintain quality--all within available resources. This paper describes faculty development, learner support, and program evaluation strategies and findings used in the implementation of ALN degree programs and courses.

1. Introduction

The University of Central Florida (UCF), one of the most dynamic and rapidly growing institutions in the United States, is quickly developing its capabilities in distributed learning. UCF's metropolitan setting in Orlando, Florida is also one of the fastest-growing regions in the nation, with an established reputation as a premiere tourist destination and as a center for high technology and space-related industrial development. The university is aggressively developing distributed learning programs, particularly asynchronous learning networks (ALN), to meet the diverse needs of its growing student population. UCF has institutionalized distributed learning by developing the technical infrastructure, providing administrative support and leadership, systematic faculty development, learner support, and a plan for ongoing assessment of distributed learning. This panel

presentation will provide an overview of the institutional approach used to develop distributed learning at UCF focusing on faculty development, assessment for program improvement, and learner support.

2. Administrative and Technical Infrastructure

Over the past two years, UCF has made significant investments in technology infrastructure, faculty and student support services, and organizational development to support both regular campus instruction and the asynchronous learning initiative. The Division of Information Technologies and Resources was formed in 1995, bringing together the Library, Computer Services (academic and administrative computing), Telecommunications, and Instructional Resources into a single administrative unit. The position of Vice Provost for Information Technologies and Resources was created to head this division, which reports to the Provost and Vice President for Academic Affairs. During 1996 a new Distributed Learning Course Development unit was formed to create ALN courses and provide related faculty development support.

In 1997, the Vice Provost for Academic Affairs reorganized his division to create the UCF Center for Distributed Learning. It has full responsibility for planning and administering the university's interactive television and ALN programs. The Center will serve as a clearinghouse for processes and resources in support of off-campus and distributed learning credit programs, courses, and students, as well as marketing for both live and distributed learning courses. It also is providing leadership and coordination for efforts to achieve accreditation for distance learning programs throughout the university.

In addition, the Faculty Center for Teaching and Learning (FCTL) was created and a Director appointed. The FCTL is undertaking campus-wide, faculty-led systemic initiatives to improve the UCF teaching and learning environment.

Informal seminars on instructional uses of the web which highlighted entrepreneurial efforts by individual faculty who piloted web-based courses were organized and fed into the normal planning process of the university. This led to the identification of a model to incorporate the best practices discovered in these seminars into the mainstream activities of the University. The UCF model for ALN development that resulted can be summarized as follows:

1. Needs assessment: Determine the market or audience for courses or programs.
2. Delivery system selection: Based on the student characteristics, select the appropriate delivery mode(s).
3. Planning: Once the market and delivery system have been determined, bring academic leadership into a planning session aided by consultants knowledgeable in the delivery mode to agree upon an implementation plan and to make a commitment of resources to the project.
4. Instructional design: It is imperative that the delivery system incorporate pedagogically sound instructional design.
5. Instructional support team: Assemble an academic support team that includes faculty, technical experts and support staff.
6. Faculty development program: The faculty who will develop the courses are provided release time, multimedia computers, course templates and software and assistance in workshops and one-on-one in developing their courses.
7. Learner support system: Systems are implemented on-line and by phone to provide students access to library materials, admissions, financial aide, registration and advisement.
8. Pilot phase: The courses that are designed in the course development project are implemented with full support from the instructional support team beginning with a course orientation and including summative and formative evaluation of the course.
9. Demonstration phase: Once the courses are developed, departments begin development of full-scale program offerings. On a long-range basis, colleges assume responsibility for faculty and course support.
10. Implementation: The collegial processes for course and program approval and establishment of accreditation documentation end the planning and development stages. This is followed by marketing of the programs and courses to the intended audience.
11. Evaluation: The evaluation will assess the implications of ALN for teaching and learning at UCF by examining: 1) The impact of distributed learning on faculty instructional practices, and 2) the impact of ALN on student learning processes

3. The Transition from Distance ALN to Campus-Based ALN Instruction

In the periodic feedback sessions conducted by the project staff, faculty teaching fully web-based courses often remarked that it appeared to them that many of the students in their web courses were concurrently enrolled in traditional courses offered on campus. An examination of the students' transcripts revealed that 325 of the 424 students (unduplicated headcount) enrolled in the web-based courses had been previously enrolled at the university (or 76% of the total enrollment in web courses). Indeed, only 60 students had not previously been enrolled at the university and took courses only on the web for Fall 96 and Spring 97 and 99 students were enrolled in only a web-based course for both semesters. These data reveal that the audience for web-based courses is primarily currently enrolled UCF students who were concurrently enrolled in traditional courses. Of the 99 students who were taking only web-based courses, 63 had not declared a major and 23 majored in Education.

This analysis led to a recommendation by the project leaders to pilot a new campus-based ALN approach to instruction that would focus on currently-enrolled UCF students. The deans accepted this recommendation, and the Provost agreed to fund a pilot project for ALN enhancement of campus based courses that would address three goals:

1. Enhance classroom productivity by using a combination of ALN and synchronous course delivery. For example, a course which normally meets three hours a week, would meet only once a week, with the remainder of course content delivered over the web.
2. Improve the quality of large-classroom instruction by enhancing interactively with ALN techniques.
3. Enhance the retention (or completion rates) in courses that traditionally have low student success by using ALN techniques to increase student-student and student-instructor interaction, providing automated tutorials and monitoring student progress using ALN techniques.

In the late Spring of 1997 a Request for Proposals was issued to solicit proposals from faculty and eleven projects were funded with all colleges involved. In addition, the deans of two colleges agreed to fund an additional three courses in the project. A faculty development workshop was held in July and the first courses in the pilot were offered in the Fall of 1997.

4. Processes and Strategies

Within less than two years, UCF has come from having no coordinated ALN program to having more than 200 fully on-line and substantially Web-enhanced courses, and numerous others that make significant use of the Web. Having observed the successes resulting from the initial round of on-line courses, our colleges have reaffirmed their commitments to continue and expand on-line offerings.

Expedited planning and decision making has been a characteristic of our ALN program from the beginning. Elements that have made this possible include obtaining the commitment of the university's senior administrators, from the President through the college Deans; working with faculty in cohort groups, providing central coordinated course development support; the use of distance learning advisory committees with broad participation from the colleges and branch campuses; a strong working partnership between the course development group and the Division of Information Technologies and Resources, whose units provide technical infrastructure and support for the on-line programs; and the use of a nationally-recognized consultant, who worked with our Deans and planning groups to shape our policies and directions. These working partnerships continue to be refined and cultivated.

Throughout this process, we have sought to develop and refine our ALN activities as models. These models include:

1. A pedagogical model. All of UCF's ALN courses utilize an educationally sound structure based on the prototype developed by Sorg and Truman. This model has been continually enhanced as new tools and techniques have become available.
2. A planning model. Distance learning is a dynamic activity, and the institution must have an equally dynamic planning process. As discussed above, we have developed a highly effective and cordial planning process that has facilitated the rapid development and deployment of on-line courses and programs.
3. A course development model. Based on the work of Sorg and Truman, and with the input of faculty who have participated in earlier course development activities, a course development and support structure has

been put in place that forms a close collaboration between the individual faculty members and the course development group.

4. A delivery model. A close working partnership has been formed between the on-line program and the Division of Information Technologies and Resources (which includes Course Development and Web Services, the Library, Computer Services, Telecommunications, and Instructional Resources). This collaboration has resulted in extensive improvements to the campus infrastructure to facilitate faculty and student participation in these courses. Examples include the dedication of a Web server to ALN course delivery and substantial expansion of the campus modem pool.

5. Faculty Development

Interactive faculty and course development workshops were held in July 1996 and in September-October 1996. During the summer, faculty were expected to attend five, three-hour workshops. Critical technical skills were handled on an individual basis based on need. Distance learning technologies were used and modeled. Course Development Web pages were created with photographs both posed and candid shots of participating faculty. Links were made to all the Web content handouts, computer conferencing forum, Web page generator and forms for supplying feedback.

One of the greatest needs for systematic faculty development in developing Web-based courses is the need for faculty to prepare themselves for their change in role from lecturer to facilitator. Another consideration in the quality of designing a distance course is the faculty member's ability to relate to students. Therefore, initial faculty development workshops included: understanding the philosophy of distance learning, dealing with copyright, adapting teaching strategies, designing interactive courseware, identifying learner characteristics, organizing instructional resources for independent study, using telecommunications systems, collaborative planning and decision making, and evaluating student achievement and perceptions.

Institutionalizing faculty development for ALN course instruction has provided cross discipline sharing of teaching techniques and has produced cohorts of faculty across all five colleges who continue to meet and discuss the teaching and learning process and evaluate their successes and failures. The faculty development process has evolved to a model ALN 'course' approach. Faculty members are exposed to the tools and processes used in teaching ALN courses through a combination of asynchronous activities and through presentations by and discussions with faculty experienced in teaching ALN courses. Instructional design is an integral part of faculty development providing all faculty with the tools needed to reengineer existing courses or develop new courses for delivery on the World Wide Web.

The processes used in systematic course and faculty development have enabled the support of many faculty and courses while maintaining quality. Course developers act as change agents to facilitate model and process building across disciplines for faculty with varying levels of technological ability and experience. A cultural change is encouraged among faculty through the development of faculty cohorts that transform the teaching and learning process through collaborative, experiential learning, and modeling ALN principles such as learning communities.

High quality course materials are created through a team that consists of subject matter experts (faculty), instructional designers, programmers, and graphic artists. Course development staff work directly with faculty to provide a professional model for building course materials. With this approach, faculty members are not required to possess knowledge of HTML programming or multimedia production. They are supported so that they may concentrate on teaching and learning in ALN courses.

Learner support materials and processes have been and are being developed so that distance learning students may have access to the same support services available to on-campus students. Faculty are prepared through the faculty development program to provide essential learner support. They develop course operational protocols that provide learners with a consistent and understandable ALN environment, intervention strategies designed to help individual and groups of learners. The university is moving rapidly to provide all students with electronic access to all campus services, admission, registration, tutoring, and advising.

6. Evaluation of ALN Programs

In an effort to determine the impact of online courses on both faculty and students, UCF began a pilot study in 1997 to examine teaching and learning in the ALN environment. This evaluation project will focus on assessing the implications of ALN for teaching and learning at UCF by examining:

1. the demographics of students who enroll in ALN courses;
2. the perceptions of students who have enrolled in ALN courses;
3. the perceptions of faculty toward the experience of teaching in an ALN setting;
4. the impact of ALN on faculty instructional practices; and
5. the impact of ALN on student learning processes.

To date, this pilot work has focused only on those courses that have been offered entirely in ALN mode with no face-to-face meetings beyond an orientation on the first day and perhaps a final examination. Data from ALN-enhanced format courses are currently being examined.

Preliminary data collection and analysis indicate a high level of satisfaction by students regarding their on-line course experiences. Students, who tend to be older than traditional college age, are working full time and pursuing their course work on a part-time basis report that saving driving time by not driving to campus as the primary reason for taking on-line courses.

Faculty report a high degree of satisfaction teaching on-line courses. At the same time they confirm our beliefs that teaching on-line courses takes more time than traditional courses. They report that in spite of the work involved, they are reinvigorated by the experience and will continue to teach on-line courses.

7. Summary

Support for distributed learning from the highest levels of university administration has provided an environment in which on-line courses and degree programs are developing rapidly. Faculty and students are fully supported by free access to the technical infrastructure and by qualified professional personnel and talented students. The human infrastructure has been key to the university's successful venture into enhancing student educational opportunities through learning on-line.

USERS' SEARCHING BEHAVIOR ON THE EXCITE WEB SEARCH ENGINE

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Abstract: This paper reports the results from a major study exploring users' information searching behavior on the EXCITE search engine. Three hundred and fifty-seven (357) EXCITE users responded to an interactive survey, including their search topics, intended query terms, EXCITE search frequency for information on their topic, the results of previous searching and demographic data. Results show that: (1) users tend to employ simple search strategies, and (2) users perform successive searches over time to find information related to a particular topic.

INTRODUCTION

The majority of Web search services that use search engines as the access mechanism to Web resources using information retrieval (IR) techniques, i.e., Boolean queries, relevance ranking. Few studies have investigated user behavior and access to the Web search services, i.e., EXCITE. However, user behavior found common by IR systems users' can also be investigated with Web users. Recent IR systems research shows that users with a problem-at-hand often seek information in stages over extended periods and use a variety of information resources [Spink, 1996]. Over time users tend to search the same or possibly different interactive systems (digital libraries, IR systems, Web services) for answers to the same or evolving problem-at-hand. This process is called the *successive search phenomenon.* How access to heterogeneous collections on the Web can be designed to assist users in their successive searches is an important research question. However, users successive searching currently receives little, if any, support from present interfaces, procedures, or search engines. Interactive IR systems are largely built following a single search paradigm, i.e., they are designed and operate on the assumption that every search is an end in itself. Despite the intense interest in the Web, there has been little research investigating users Web searching behavior. The aim of the study reported in this paper is to explore users searching behavior, and the extent to which users perform successive searches on the EXCITE search engine. Results are reported from a major international study of users' interaction with the Web search engines EXCITE. Users of the web search service EXCITE, Inc. were asked to complete an interactive survey form about the nature of their interaction with EXCITE, including their current search topic, search terms, information seeking stage, and frequency of searches on EXCITE on their current topic. The survey results are supplemented with results from a quantitative analysis of 18,113 EXCITE users and their 51,472 queries [Jansen, Spink, Bateman & Saracevic, 1998].

The phenomenal growth of the size of the Web has created a growing body of empirical research investigating many aspects of user interactions with the Web. Experimental and comparative studies show little overlap in the results retrieved by different search engines based on the same queries [Ding & Marchionini, 1996], and many differences in search engine features and performance [Chu & Rosenthal, 1996]. Surveys of Web users are generally library based [Tillotson, Cherry & Clinton, 1995] or distributed via newsgroups [Perry, 1995]. Recent studies [Pitknow & Kehoe, 1996] found major shifts in the characteristics of Web users over four surveys from 1994, including a growing diversity of Web users based on age, gender, and access through both the office and home computers. This paper reports results from the first Web survey and study conducted directly through a major commercial search engine. Research shows that humans seek information in stages over extended periods as their information problem evolves and changes [Kuhlthau, 1993] and use different types of IR systems during an information seeking process (i.e., Web, CD-ROMs). Data from several recent studies highlights the need for studies investigating users successive search behavior. Recent studies show users conduct successive mediated IR searches [Saracevic, Mokros, Su & Spink, 1991; Spink, 1993], end-user searches [Huang, 1992] or OPAC searches [Robertson & Hancock-Beaulieu, 1992] when seeking information related to a particular information

problem. At present, limited knowledge exists on successive search behavior by Web users.

The objective of the study reported in this paper was to gather data on the use of the major Web search engine EXCITE to provide a preliminary model of user characteristics and search behavior. Specifically, data was collected on users: (1) demographic characteristics, (2) search topics, (3) search terms, strategies, and (4) successive searching behavior. Data was gathered through an interactive eighteen (18) question survey form, developed by Dr. Amanda Spink from the University of North Texas in conjunction with EXCITE, Inc., and made available through EXCITE's Home Page for 5 days from Friday April 11 to Tuesday April 15,1997. Only those users who accessed EXCITE's Home Page (http://www.excite.com) could access the survey form (http://www.unt.edu/survey/excite.html). The total number of visitors to the survey site was 3729. Four hundred and eighty (480) users clicked the 'Send Survey" button at the end of the survey form. From 10am to 2pm on Saturday April 12 was the period of heaviest usage of the survey form.

RESULTS

Only 316 of the 480 survey forms contained usable data. Some respondents did not provide answers to each survey question. The next section of the paper outlines the respondent's demographic characteristics.

Respondents ranged in *age* from less than 10 years to over 60 years, with the majority between the age of 20 and 50 years (Table 1).

Age of Respondents		
Age (Years)	**Number**	**%**
Under 10 Years	4	1%
11-20 Years	48	16%
21-30 Years	69	23%
31-40 Years	58	19%
41-50 Years	62	21%
51-60 Years	36	12%
61+	24	8%
Total	**301**	**100%**

Table 1: Age of survey respondents.

Most respondents were either high school or college graduates (Table 2).

Education Level of Respondents					
Education Level	Number	%	Education Level	Number	%
High School	57	19%	Professional	14	5%
Vocational	24	8%	Masters	46	16%
Some College	71	24%	Ph.D.	9	3%
Bachelors	70	24%	Student	2	1%
Total				293	100%

Table 2: Education level of survey respondents.

Students and professionals formed the largest group of respondents, followed by executives and the self employed (Table 3). Overall, many respondents were from business or academic related environments.

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Occupation of Respondents					
Occupation	Number	%	Occupation	Number	%
Student	55	19%	Consulting	14	5%
Professional	38	13%	Services	14	5%
Executive	29	10%	Research & Development	11	4%
Self Employed	25	9%	Clerical	10	4%
Technical	16	6%	Marketing	8	3%
Faculty/Academic	14	5%	Other	50	18%
Total				284	100%

Table 3: Occupation of survey respondents.

Interestingly, the largest group of respondents were searching EXCITE from home - followed by commercial and educational users.

Computing Domain of Respondents					
Computing Domain	Number	%	Computing Domain	Number	%
Personal	107	36%	Government	7	2%
Commercial	83	28%	Military	2	1%
Educational	55	18%	Other	23	8%
Organizational	22	7%			
Total				299	100%

Table 4: Computing domain of survey respondents.

The overwhelming number of respondents were located in the United States (Table 5).

Geographic Location of Respondents		
Geographic Location	Number	%
North America	225	84%
Western Europe	8	3%
United Kingdom	5	2%
Latin America	6	2%
Other	25	9%
Total	269	100%

Table 5: Geographic location of EXCITE users.

Respondents accessed EXCITE from an IBM/PC or equivalent platform (Table 6).

Computer Platform Used by Respondents		
Computer Platform	Number	%
PC/IBM	201	68%
X/UNIX	38	13%
Macintosh	35	12%
Other	22	7%
Total	296	100%

Table 6: Computer platform used by survey respondents.

SEARCH TOPICS

Users were asked to describe their current search topic. Respondents current search topics on EXCITE were

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dispersed broadly over 16 search topic categories. The major topics of EXCITE searches were for information about people, companies and products.

Search Topic Category	Number of Searches	% of Searches	Search Topic Category	Number of Searches	% of Searches
Individual or family			News	19	7%
Family or friend	17	6%	Hobbies	18	6%
Public figure	11	4%	General information or surfing the web	16	6%
Genealogy	6	2%	Science	16	6%
Sub-total	34	12%	Travel	13	5%
Computers	34	12%	Arts & Humanities	12	4%
Business	30	10%	Education	10	3%
Entertainment	23	8%	Shopping	8	3%
Medical	22	8%	Graphic Images	7	2%
Politics & government	20	7%	Employment	5	1%
Total				287	100%

Table 8: Frequency of search topics

Most respondents searched on a single topic as determined by their query terms and search topic statements. Eleven (11) respondents reported searching on two different topics and two (2) respondents reported searching on three topics. Multiple search topics were determined by an analysis of the query terms and search topic statements. The topics for respondents who reported browsing or surfing, or as one respondent put it "whatever interests me", were categorized as *general information or surfing* searches.

SEARCH TERMS AND QUERIES

Table 9 provides a more detailed overview of the search terms reported by respondents. These are not necessarily the terms or phrases that respondents used when searching, but the terms that respondents reported were those they intended to use. The mean number of search terms was relatively low at 3.34. Some respondents seemed confused about what they were to report when asked to list query terms for their search. Some respondents also reported links instead of query terms and six (6) respondents used the query term area to describe their search. One (1) respondent put question marks in the query term area.

Classification	No. Of Search Terms	Classification	No. of Search Terms
Total number of respondents who reported terms	210	Proper nouns (names, places, companies, etc.	45
Total terms (did not include stop words)	701	Links	9
Mean number of terms/respondent	3.34	Described search	6
2-term phrases	84	URL	1
3-term phrases	9		

Table 9: Search term data.

BOOLEAN OPERATORS

Many respondents included terms that they clearly meant as a phrase or proper name, but no respondent indicated that they would use quotes (EXCITE'S method of indicating that two or more words should be next to each other) around these phrases. Some respondents reported the format and syntax of their search query in addition to the search terms they planned to use. Few search statements included Boolean or other operators. Of the ones that did: (1) 4 queries included AND, (2) 2 queries included OR, and (3)11 queries included +. The findings indicate that few users employ Boolean operators and even fewer users read instructions and use the correct syntax to enter

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search phrases and Boolean operators. The EXCITE user search logs recently analyzed [Jansen, Spink, Batemen and Saracevic, 1998] support this low use of Boolean operators, with only 2694 (5.24%) of queries containing Boolean operators.

SUCCESSIVE SEARCHING BEHAVIOR

Users were first asked how frequently they searched EXCITE for information in general. Many respondents reported searching EXCITE on a daily basis to find information, and nearly a third of respondents also searching EXCITE weekly or at least 2-3 time per week (Table 10).

Frequency of EXCITE Searching:		
Frequency of Searches	Number of Users	% of Users
First Search	51	17%
Daily	124	42%
2-3 Searches	57	20%
Weekly	45	15%
Monthly	19	7%
Total	292	100%

Table 10: Frequency of EXCITE searching by users.

Table 11 shows that many users were conducting *successive searches* when seeking information on a particular search topic.

Matrix of Information Gathering Stage By Number of EXCITE Searches			
EXCITE Searches	Beginning Stage	Still Gathering	Competing Information Gathering
First search	63 (23%)	35 (13%)	7 (3%)
2-5 searches	23 (8%)	48 (18%)	11 (4%)
6-10 searches	8 (3%)	16 (6%)	7 (2%)
11-15 searches	2 (1%)	6 (2%)	2 (1%)
15-20 searches	2 (1%)	4 (1%)	2 (1%)
20+ searches	6 (2%)	26 (10%)	4 (1%)
Total (272 users)	104 (38%)	135 (50%)	33 (12%)

Table 11: Matrix of users' information gathering stage by number of times EXCITE searched for information on current topic.

The largest group of EXCITE respondents (23%) were conducting their first search at the beginning of their information seeking process on their current topic. Some 26 (10%) users reported still gathering information after more than 20 EXCITE searches. The largest group of respondents estimated that they had conducted from one (1) to five (5) searches, many at the beginning and still gathering stages of their information seeking process.

Users were then asked if they had retrieved *any relevant information* from EXCITE on their current topic. Most users 72% reported retrieving relevant information from EXCITE on their current topic on current topic.

Those respondents who had conducted successive searches were asked if their *search terms had changed* over successive searches. Fifty four percent (54%) of *successive search users* reported changing their search terms on their current topic over successive searches. However, the other half of successive searchers reported "still gathering" or "completing" with no change in their search terms over successive searches. This finding was not surprising, as previous studies [Spink, 1996] reported similar findings with IR system, CD-ROM and Online Public Access Catalog (OPAC) users. Successive searching involves potential changes and shifts in many variables, such as changes in search terms, search strategies, relevance judgments and criteria, or information problem focus. The study did provide a rich set of data and some surprising findings that are discussed in the next section of the paper.

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DISCUSSION

EXCITE users range across most age groups with different educational and occupational backgrounds from academia to business. They prefer to access the Web via IBM PC's and are largely scattered across North America. Their search topics are various, with some focus on business and computing topics. However, the lack of sexually motivated search topics and terms was rather surprising. This result was probably due to self-censorship on the part of the respondents to completing a survey form. In contrast, a recent study [Jansen, Spink, Bateman & Saracevic, 1998] found sex to be a major search topic during an analysis of over 51,474 EXCITE search queries from over 18,113 EXCITE users. EXCITE users were also not proposing to use many search terms or search features, such as Boolean operators, query modifiers or natural language queries. This finding implies a fairly low level of interaction with the EXCITE search engine. The successive searching results also suggest that users were willing to come back for another related search at a later time. This finding is further supported by [Jansen, Spink, Bateman & Saracevic, 1998], who found that EXCITE users performed limited query reformulation and had little persistence in viewing retrieved lists of Web sites. Users also indicated that they were performing successive searches over time related to the same information problem. Web users need to save their search terms, strategies and results for further reformulation. The successive search phenomenon needs further investigation with digital library, IR or Web users. Search term and strategy selection tools might also help digital library users, particularly those in successive search mode. An additional aid could be a preprocessing of a user's query checking for lower case "and", spaces after "+", etc. The user could be prompted to possible syntax and spelling errors. through the user interface. The development of interactive tutorials for users of the Web and digital libraries might also help them to interactively learn the basics of effective searching.

This study extends the previous research findings by [Spink, 1996] in relation to the general practice of successive searching by users of interactive IR systems. The key area for further research is to model the changes and shifts that occur within and between successive searches by Web users.

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A Real Time Internet Auction System

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Abstract: Electronic commerce is gaining wider acceptance by the industry as a means of cutting cost for business processes, and improving their quality. Some examples of these processes are: payment and fund transfer, invoicing, inventory management, cargo tracking, etc. In past, the infrastructure required to enable these processes was expensive or too proprietary to gain wide acceptability. With the advent of World Wide Web and Java, this is changing. Java is enabling rich interactive Web applications that are portable across different platforms. At the Old Dominion University, we have established a research program where we are looking at building Java class libraries to support electronic commerce applications over the Web. One such class library that we have developed is to supports real time updates. We have used this class library to build an Internet Auction prototype, which is the focus of this paper.

1 Introduction

Electronic commerce is gaining wider acceptance by the industry as a means of cutting cost for business processes, and improving their quality. Some examples of these processes are: payment and fund transfer, invoicing, inventory management, cargo tracking, etc [Adam & Yesha 97]. In past, the infrastructure required to enable these processes was expensive or too proprietary to gain wide acceptability. For example, EDI transactions have been traditionally supported on proprietary value added networks. However, with the popularity of Internet and World Wide Web, this is changing [Shi et al. 97a, Shi et al. 97b].

The World Wide Web is growing exponentially, thus, making it an attractive framework for a variety of applications. Today the World Wide Web is the most cost-effective way to share information among geographically dispersed users [Stien 97]. The graphical Web browser's ease of use makes internationally distributed multimedia information accessible to anyone with access to the Internet. The Web seamlessly connects disparate hardware platforms running on different operating system in diverse locations. With the advent of Java technology, Web applications can now support highly interactive Web clients. Java applets, because of their ability to run on a client machine and establish communication to a process on the Web server, are ideal for developing interactive applications [Cornell & Horstmann 97].

There is a need for tools and class libraries to deploy electronic commerce applications over the Web fast and cost-effectively. At the Old Dominion University, we have established a research program where we are looking at building Java class libraries to support electronic commercial applications over the Web. One such class library that we have developed is to supports real time updates. We have used this class library to build an Internet Auction application, which is the focus of this paper. The real time update requirements occur in many electronic commerce Web applications such as Auction over the Internet. For example, in an Internet Auction application, a bidder would be interested in monitoring the bidding pattern in real time for an item, before deciding on his bid. A

naïve way to support this is by periodically updating the bidder screen. (On Web, it implies reloading the document periodically.) This may be reasonable for some scenarios; however, in general it puts more traffic on the network and will not be in synch with the bid events. There is a need to refresh the bidder's Web document as and when a bid for an item (he is interested in) is received. In fact, Web pages for all the bidders who are interested in that particular item need to be refreshed. This is not possible with the current HTTP protocol and plain HTML documents. As this requires some logic to be present on the bidders document that can receive a message for updating the document. In addition, it requires software on the server side that keeps track of the bidders and the items they are interested. We have built Java based class libraries to support these requirements. The classes can be used with other Web based applications that require real-time updates. These classes are portable to different platforms, as they have been implemented in Java. We have implemented an Internet auction prototype based on these classes that can be tried at URL: http://www.cs.odu.edu/~ecomm_e/auction1.0.

The rest of the paper is organized as follows. We discuss the Internet Auction architecture and the motivation for real time update classes in the next section. In Section 3, we discuss the Internet Auction architecture implementation based on real time update classes. Section 4 discusses the current prototype. Finally, in Section 5 we have the conclusion.

2 Internet Auction architecture

A typical scenario for using an Internet auction system is as follows. With the help of a Java enabled Web browser, a user (bidder) visits the auction Web site and sees a list of items along with their current bid price and bidding history. He selects a sub-list of items of his interest for *monitoring*, and follows the bidding pattern before he decides to bid. This requires updating of the sub-list on the user screen as and when a new bid for an item in this sub-list is received. After monitoring the bidding pattern, the user may decide to bid on an item. Consequently, all clients monitoring this item need to be informed. The focus of this paper is to design an Internet auction architecture that supports this real time behavior. In this architecture, we do not address other equally critical modules such as security, time stamping, non-repudiation, etc [Ahuja 97, Bogen et al. 97].

The Internet auction architecture to support real time updates is shown in [Fig. 1]. In this architecture, the Java applet and the auction monitor are the two key modules that provide the real time update feature of the auction. The Java applet is downloaded when a user selects a sub-list to monitor. The auction monitor tracks different web clients participating in the auction. Once a new bid is submitted, the auction monitor informs the appropriate clients of the new bid. The Java applets on these clients reload the updated information. The other two modules of this architecture that are of interest are: Auction Gateway, and Database Server. The auction gateway interacts with the database server and the auction monitor. It consists of a suite of CGI programs that (a) identify the type of request from the user, (b) process the submitted user data, (c) read/modify the data in the database, (d) send back appropriate output to the Web browser through the Web server, and (e) communicate the status change information (new bid) to the auction monitor. The data flow to illustrate the update feature is shown in [Fig. 2].

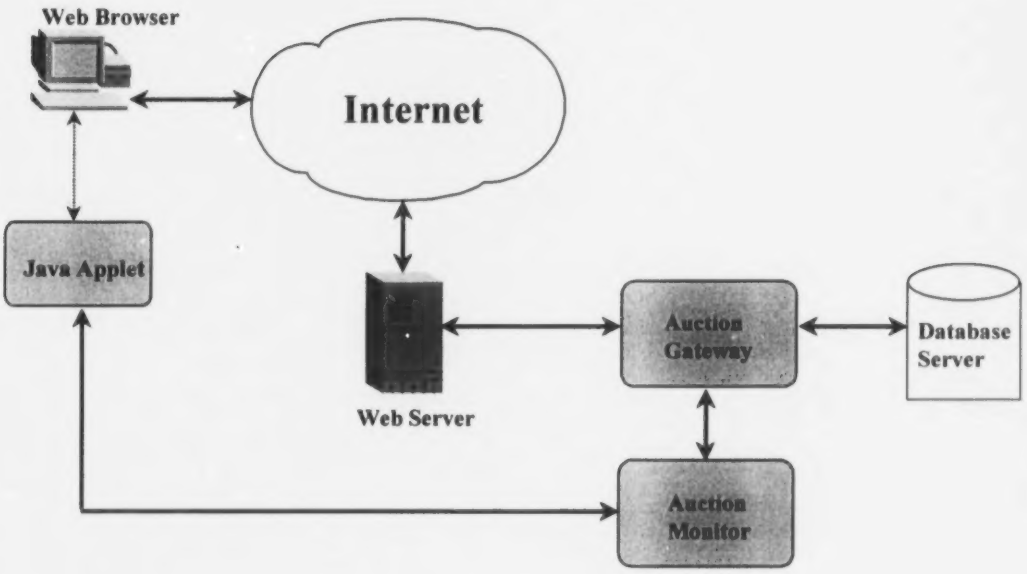
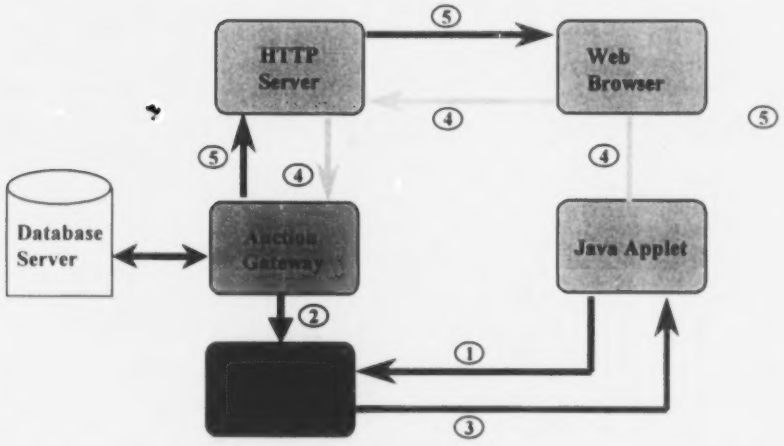


Figure 1: Internet Auction Architecture.



① Applet establishes communication with auction monitor

② Auction monitor gets the status change information

③ Auction monitor sends the status change signal to the applet

④ Applet sends the update request to the server

⑤ Auction gateway sends the updated page

Figure 2: Data Flow to Update the New Bid Information.

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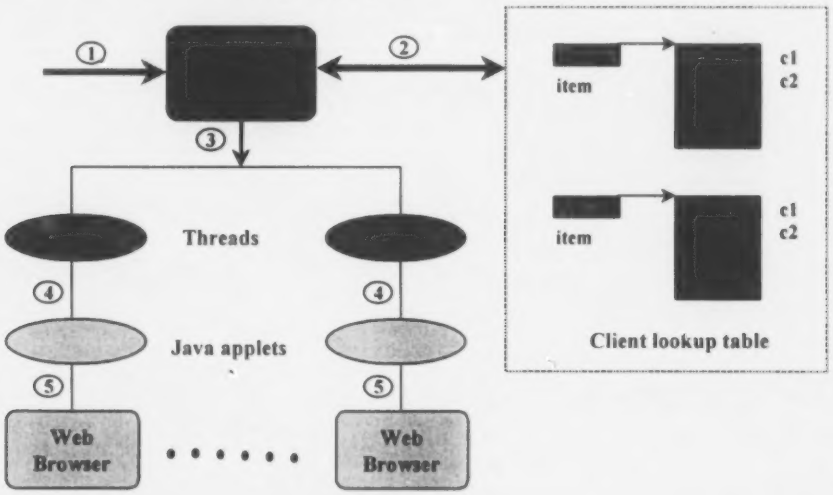
3 Implementation

To be able to appreciate the class library that we have developed to support real time updates, we will first discuss the implementation approach for the auction monitor and the Java applet module. Later we describe the class library that enable these modules and discuss how this library can be used for enabling other applications with real time update requirements.

3.1 Auction Monitor and Java Applet

The auction monitor is a multi-threaded implementation where a thread handles the communication with an active Java applet on the client (Web browser). Auction monitor maintains a look-up table to keep track of all the clients that are interested in a particular item. In other words, for an item in the auction, a list of clients that are monitoring this item is maintained. Any new bid for an item is communicated by the auction gateway to the auction monitor. This triggers the corresponding thread of the auction monitor to establish communication with the appropriate applet. The applet in turn reloads the new information. This is illustrated in [Fig. 3].



① Auction gateway sends an update to the auction monitor

② Auction monitor looks up the client using data item key

③ Auction monitor sends all the thread connections about the update

④ Each thread sends an update to its respective client

⑤ Applet reloads the page

Figure 3: Auction Monitor Implementation.

3.2 Real Time Update Classes

The two modules that provide the real time functionality are: auction monitor and Java applet. The auction gateway is specific to an application and has to be customized for every application. The auction monitor consists of three major classes: (a) Connection Class, (b) Packet Class, and (c) Client Table Class. There is one class corresponding to the Java applet module and that is the Client Applet Class. The connection class along with the packet class establishes the way auction monitor communicates with the auction gateway and the Java applet. These classes provide a default protocol

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for this communication. However, these classes can be extended to support a different communication protocol. Here, we first describe the default communication protocol and then we discuss how it can be modified to support new protocols. The communication between different modules is through packets. The default packet format includes the type of the packet, the length of the packet and the actual data. The first two bytes of the packet are the length of the packet followed by one byte that indicates the type of the packet followed by the actual data. The following types of messages are supported by the default protocol defined in the connection class.

JOIN: A JOIN message is sent by the client applet to the auction monitor whenever it starts up. The data in this message is the list of items that this client is interested. As soon as the auction monitor receives this it makes an entry for this client in the client table against all the items that this client is interested in. This is used to send further updates to one of these items.

LEAVE: A LEAVE message is sent by the client applet to the auction monitor to indicate that the client is no longer interested in monitoring this item. The data sent includes the list of items.

NEW_BID: A NEW_BID message is sent by the auction gateway to the auction monitor. This makes use of a process called the Clerk that takes care of the actual communication. The data sent includes the new value of the item that was changed.

BID_UPDATE: The auction monitor sends a BID_UPDATE message to the client applet. Upon receiving this message, the applet reloads the particular page thus updating itself.

The major classes of the package are:

Monitor Class. The Monitor class is just a wrapper, which contains the main method. At startup it starts listening at any user supplied port. When a new connection is received, the connection class is instantiated that handles all further communication with the client.

Connection Class. The connection class extends java.lang.Thread. For every client that connects, a new connection class is instantiated and runs as a separate thread and handles all further communication with the client. The connection class has a default implementation for the communication protocol. This protocol can be easily extended or replaced by a totally different protocol without affecting any of the other classes.

ClientTable Class. The class ClientTable extends java.util.Hashtable and implements a key-entry kind of data-structure. The key is one of the items in the database. Against this key is a data-structure that holds the connection information of all clients currently monitoring in this item. Given a key the list of clients with their connection information can be retrieved.

For the client side, we have only one class, the ClientApplet Class.

ClientApplet Class. The ClientApplet class extends the java.applet.Applet class. This applet starts running when either the monitor or the bidding page is loaded. As part of its startup the applet establishes a connection with the auction monitor at the specified port and sends an initial JOIN message with the items that the current user is interested. When the user leaves this page a LEAVE message is sent to the auction monitor to prevent further update messages from being sent.

Using Real Time Update Classes for Other Applications. The Packet class supports a public interface that provides the data contained in the packet, its type and its size. If a user decides to use a different packet format then all that he has to do is to define his packet implementation but preserve the same public interface of the existing Packet class. In order to understand how to extend the protocol or define a new one we need to look more closely at the current implementation of the Connection class. The Connection class has two methods called processPacket() and handlePacket(). Whenever a new packet is received it is sent off for processing to the processPacket() method, which in turn passes it to the handlePacket() method. The method handlePacket() contains a switch

statement that identifies the various kinds of packets and takes appropriate action. This method returns true if the packet is handled, false otherwise. Extending this functionality involves deriving a class MyConnection from Connection and overriding the processPacket() and handlePacket() methods. The handlePacket() method must have appropriate procedures to implement the extended protocol. If the packet requires default processing and not the extended processing then it can be passed to the processPacket() of the parent class.

4 prototype

We have implemented a prototype and can be tried out at the URL: http://www.cs.odu.edu/~ecomm_e/auction1.0. The auction monitor and Java applet module have been implemented using the real time update classes and are based on JDK1.0. The auction gateway is a collection of CGI scripts written in Perl 5.0. The auction monitor and the auction gateway runs on the Sun Workstation with Solaris 5.0. For our prototype we have used mSQL as the database engine. This is where we store the list of items under auction, the bidding history, and other related information.

5 Conclusion

In this paper, we discussed the design and implementation of a Java package to support real time updates for Web applications. We used this package to implement an Internet auction prototype. These classes are designed to be used for other Web applications. We are currently looking at the extension of this package to support other electronic commerce applications requirements like time stamping and security related features.

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An Adaptive Hypertext Model for Organizing Personal Information

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Abstract: It is becoming increasingly difficult to manually maintain effective information structures in complex and dynamic task environments. In order to address this problem, we are exploring the possibility of using the hypertext metaphor in a new way by using the concepts of probabilistic linking and relevance feedback. The result is intended to augment existing personal information structures by means of an adaptive hyper structure.

1. Introduction

The increasing volume of computer-based information following the use of advanced information technology produce a need for more effective ways of organizing information within the personal workspace. Studies on how people use the computer as a tool for organizing their information gives that they seldom get acquainted with functions to organize and maintain the stored information, but concentrate upon task accomplishment in a way that satisfies the constraints within the working environment [Carroll 1987]. As a consequence, information tends to remain in the same place or category within the information structure (i.e., in the file system) as it was put originally when it first entered the system. When task environments change the information organization becomes more and more inadequate which makes the information progressively harder to find when needed, yet people are reluctant to reorganize the information due to lack of time and/or uncertainty of whether or not it would be worth the effort. In a similar way, the decision what information to delete, and when, is determined more by circumstances than by rules [Barreau 1995].

This paper describes a system that creates a personal, dynamic hyper structure over the information used. The purpose is mainly to provide short access routes between information that tend to be used in concert, and also to produce information to support decisions on what information to delete or reorganize physically. Documents are left unchanged at their original places (e.g. on the WWW, a file server or locally) and are manipulated by means of regular tools. The mechanisms that dynamically adapt the hyper structure to characteristics of the work process are outlined in the following section. The current work has been delimited to WWW-based information.

2. Adaptive Organizing of Personal Information

Although the hypertext concept looks appealing from a presentational perspective, the prevailing HTML standard does not provide a solution to the update problem in that the links are unidirectional and embedded in the referring document. This, together with the fact that the links must be set explicitly makes the process to create and maintain hypertexts coded in HTML too time-consuming to be a viable option for the purpose of organizing personal information. In the current project we use the hypertext model in a general sense, together with relevance feedback acting at the level of document indexing.

2.1 Utilization of the Hypertext Model

The interesting feature with hypertext (or more generally, the network model) is the potential to reflect differences in the informational content of a document depending on context: the same document can be referenced in several documents giving different messages. In the current project we are creating a personal hyper structure over documents found on the Web in which the original links are of secondary interest only (the

ones included in the HTML). We are using the hypertext model to represent the users search behavior, whatever caused it. The personal hyper structure is modeled in the following way:

- Links are stored separately: a hyper structure in a strict sense is created, which means it is separated from the documents which are to be associated. In the prototype environment they happen to be WWW documents but could in principle be of arbitrary type.
- Primary link attributes that are used in the current application are the identifiers of the associated nodes and link strength. The benefits of using an extended link notion representing different kinds of relations will be investigated, either as a free text comment or as a choice among predefined link types. In this way the meaning of a link could differ, representing producer-product relationships or semantic information, for instance.
- The visited nodes are modeled by the following attributes: the URL, document title, and the time of visit.

2.2 Systems Design Issues

Standard solutions are utilized as far as possible. In the prototype environment data about the nodes a user visits are caught by a proxy server and stored in a database. The data is the input to an 'association manager' that generates link hypotheses and stores them in a link database. An 'association visualizer' component then presents an image of the stored link hypotheses to the user which provides him/her with a number of associated links to follow in a way that parallels the use of the history list in a modern web-browser. This closes the feedback loop (fig. 1 below). An objective is to create an interactive interface to the association visualizer in order to simplify access to the presented information.

Important questions in the project concern evaluation of different criteria and rules that controls the operation of the association manager. Different kinds of evolutionary strategies are explored. For instance, an association between two documents could be created if the documents in question were visited within a sufficiently short timeframe, and the duration of the visit exceeds a specified duration as a relevance indicator. Initially the strength of a new association is set to 50%; if the association is used again later on, the association is made stronger. An important aspect of memory is the ability to forget; this is modeled by a periodic recalculation of the strength of all associations with the goal to tune down associations that are not used sufficiently often.

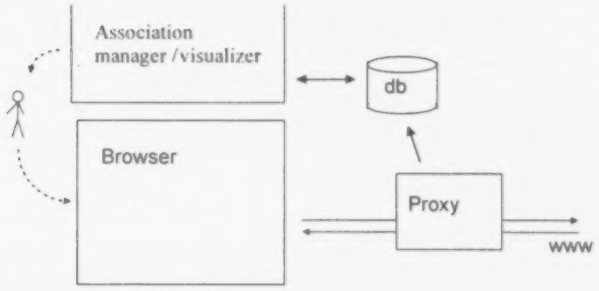

Figure 1: Systems Overview

3. Concluding Remarks

The main contribution of the project is an increased understanding of requirements on support functions for the organizing of personal information. If the outlined evolutionary strategies turn out to be useful, similar principles could influence the design of future file systems and operating system services since it is reasonable to assume that arbitrary document types could be organized accordingly.

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Effective Access to Healthcare Research Evidence in the New Information Media

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Abstract: The demands that evidence-based healthcare place on today's medical students and healthcare professionals have led to frequent claims of 'information overload'. In the context of the WWW and the other new information media, sorting 'good' evidence from 'bad' has become an unavoidable and vital task. Access to appropriate research evidence is widely recognised as crucial, but initial findings of this ongoing study suggest that e*ffective* access means more than just increased availability of the technological infrastructure which makes digital searches possible. It was also found that, although there seem to be significant barriers to effective accessing of healthcare research evidence sources via the new information media, there are signs that clinicians are equipped to overcome them given appropriate hands-on training led by information specialists. Methods being used are: 1. Systematic review of the literature; 2. 'Diary scenarios' of search activity amongst multidisciplinary healthcare professionals in a UK teaching hospital; 3. Survey of healthcare staff's perceptions of own competence in digital searches before and after receiving formal training sessions; 4. Building 3 prototype WWW sites (i) for a multidisciplinary healthcare team (Salford Diabetes Centre) as an exemplar of the digital skills needed by clinicians; (ii) for a teaching hospital's medical library (Hope Hospital, Salford); (iii) for a regional medical research support network (North West Health Libraries).

1. Introduction

The Internet and the rest of the new information media now offer almost instant access to a bewildering range of answers to healthcare research questions. Sorting 'good' information from 'bad' has therefore become an unavoidable but vital task for the health professional. The strain of 'information overload' has been apparent for some years [Lock 1982] and there is a danger that clinicians and trainees will be tempted to ignore the wealth of research evidence available via digital media because of the problems in effective access.

A key part of effective patient care is clinical decision support. In practical terms, this means promptly and effectively identifying likely interventions from a critical appraisal of the alternatives. The model clinician then uses professional skill and experience to select the best answer in the particular local circumstances. Access to appropriate research evidence to enable this decision-making is a crucial element in modern healthcare practice:

"NHS Trusts and Health Authorities have a responsibility as good employers, and as providers and commissioners of high quality evidence-based care, to ensure that all staff have access to the information needed to carry out their work effectively" [Dept of Health 1997]

Effective access however, means more than just the availability of the technological means which make it possible. An information economy requires more than infrastructure investment [Zuboff, 1989]. New information skills for the new media must be learned as part of each medical student and clinician's continuing professional development.

2. Background

GEMISIS 2000 (Government, Education, Medical, Industrial and Social Information Superhighway) is a collaboration between the University of Salford, Cable and Wireless Communications, the City of Salford, the City of Manchester and Manchester Training and Enterprise Council. The project aims to develop user driven applications that exploit the sociological, economic and technological benefits of the Information Superhighway in order to assist in the regeneration of the North West of England [GEMISIS 1998]. GEMISIS is a continuing programme testing prototype applications and projects which aim to use the Internet and related information and communication technologies to *serve* society rather than merely entertain it. The underlying hypothesis being tested is the idea that the new information and communication technologies can be harnessed to provide real benefits to society, rather than just arcade games or pay-per-view TV. There is little doubt about the new media's potential but:

'experience to date makes it problematic to characterize the commercial potential of the information highway, its actual social impact, and whether the protocols, technologies, carriers and equipment on which the implementation is based are an adequate basis for future development. The information systems industry is well known for over-ambitious expectations of technologies and their impact - a decade ago 'expert systems' were going to revolutionize industry and create a new five billion dollar industry - they did neither' [Gaines, 1996].

Because the degree to which the new information media can be used to make a positive difference to people's lives is as yet unknown, it is imperative to understand the likely problems and evaluate potential solutions.

3. Aims

3.1 Approach

This ongoing study is testing the hypothesis that, due to the nature of the new information media, there are significant barriers to effective accessing of healthcare research evidence sources, but that with appropriate training most clinicians and health students are able to overcome them.

In the pre-digital age, a systematic search of the published evidence on a given healthcare topic was a laborious task which some clinicians either delegated to medical librarians to do on their behalf, or avoided altogether. Nowadays however, the relative ease with which a useful search can be done has meant that locating and evaluating research evidence sources is increasingly being done by healthcare professionals themselves [Asta 1998]. Although the near future promises intelligent electronic agents which trawl the evidence base on behalf of clinicians; in the real world of today, the searching and filtering is being done by clinicians on the ground. How skilled they are at making the most of those available electronic resources is not clear.

In short, clinicians cannot avoid the necessity of searching the digital knowledge base, so it is crucial that they can do it effectively. Simply providing access to the technology is not enough: 'there are a lot of databases out there and a lot of journals and a lot of choices... to just turn people loose without a good sense of what is there is not a responsible thing to do' [Asta, 1998]. Barriers to effective use of the new media must be identified and overcome, with appropriate training made available for clinicians and students as a result of those investigations.

3.2 Objectives

There are three main objectives of the study:

3.2.1 Identifying the problems involved in effective accessing of healthcare research evidence sources via Web and other digital media. (*What are the barriers to effective access?*)

3.2.2 Preliminary testing of potential solutions to those problems utilising the WWW. (*How can the*

WWW be used to train health professionals to get over these barriers?)

3.2.3 Testing of the hypothesis that with appropriate training most health professionals are able to overcome the barriers to effective accessing of Web-based research evidence sources and those in other digital media *(Are health professionals getting over the barriers now*?)

4. Methods

There are four main methods being used. These are:

(i) Design of three WWW sites [see Fig 1.0] from an essentially scenario-based viewpoint. Despite receiving a good deal of hype as a flexible multi-purpose information systems design approach, scenarios have at least recently been used with some reported success in the evaluation and redesign of a WWW site in an academic setting [Erskine et al, 1997].
(ii) Systematic review of the literature
(iii) An adapted form of 'diary scenarios' [Nielsen, 1995] for capturing user requirements in terms of appropriate digital search training methods.
(iv) Questionnaire survey of health professionals and students after they have received formal digital search training so as to establish the degree of improvement (if any) in their search skills as a direct result.

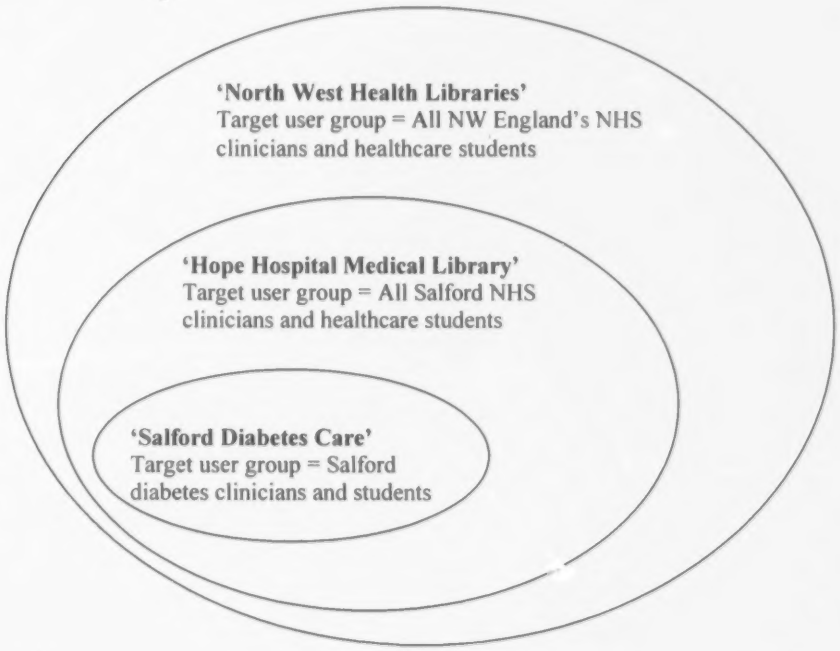
'North West Health Libraries'
Target user group = All NW England's NHS clinicians and healthcare students
'Hope Hospital Medical Library'
Target user group = All Salford NHS clinicians and healthcare students
'Salford Diabetes Care'
Target user group = Salford diabetes clinicians and students

Figure 1.0: Hierarchy of websites aimed at improving healthcare research evidence access

4.1 Salford Diabetes Centre

Construction of a basic WWW site for the personnel of Hope Hospital's diabetes centre provided names of staff involved, online CVs, contact details including email addresses, clinical services provided, research interests, details of specialist clinics etc. Quality guidelines for the production of healthcare websites summarised by [Wyatt 1997] were used. The site is mounted on the University of Manchester network at Hope Hospital and the initial website formed a basic discussion document or opening 'scenario'. Initially, information provided by Centre staff in response to the author's loose suggestions was reproduced almost verbatim on the website, with little editorial input other than retaining a common look and feel to pages. [Kay et al 1991] provide a typical example of why this 'just

do it' approach may be preferable to more exhaustive methods early in the product life cycle when users are unfamiliar with the new media :

'Designer: "How would you like to enter your data? What would you like the system to do?"
User: "Well, what can it do?"
Designer: "Whatever you want...what would you like it to do?"...and so on'

The approach used draws on the rationale for the 'rich picture' diagrams involved in the initial brainstorming in soft systems methodology (SSM) techniques e.g. see [Checkland 1990] and ideas from scenario-based approaches to the design of information products [Nielsen 1995] [Erskine et al 1997]. To some extent the website may be thought of as an online document akin to a departmental CV (which have been encouraged at Salford Royal Hospitals NHS Trust and within Manchester University's Faculty of Medicine).

4.2 Hope Hospital Medical Library

This website functions as an informed interface to sources of research evidence on the Internet and in other formats (including non-electronic) available locally. Since its formal launch just three years ago [Hukins & Pitcher 1995] the continuous development of the site has been informed by feedback from training sessions and staff use and has been remodelled to cope with network innovations and local changes in hardware. The chosen approach to capturing user requirements described below [4.5 Diary scenarios of search activity amongst multidisciplinary healthcare professionals] is essentially a formalised version of over two years' experience in redesigning the site in the light of observed faults and user problems recorded in an ad hoc manner. The format has been altered so that it mirrors search behaviour observed in the library. For example, users are not simply presented with a large amount of links. Instead, users are guided to appropriate resources according to more traditional types of information seeking. For example, the link 'Find Books' points the user to the library's own online catalogue as well as OPACs from universities, the British Library, the BMA etc, plus online booksellers which serve as databases of books in print. The home page simultaneously helps train completely new users (who may never have used a computer or a mouse before) and also serves as a launchpad for more experienced searchers.

4.3 North West Health Libraries

This website connects clinicians with sources of research evidence in their own workplace and in the c100 health libraries and information centres across the rest of the UK National Health Service's North West region. Building on the experience of other regional initiatives in the UK Health Service e.g. [Stephenson et al 1997] this site aimed to make the most of existing expertise and network infrastructure, and a readiness amongst library and information staff to be involved and to try out their ideas. It is envisaged that the site will represent best-practice in promoting effective access to research evidence across the region. It is likely that the site will form ultimately form one node in a UK network of similar regional sites.

4.4 Systematic review of the literature

It was soon apparent that a review of the literature would go far beyond the merely technical. Indeed, useful contributions to the debate were found in the literature of a number of related fields including epistemology, knowledge management, human-computer interface, information design, psychology and cognition, information storage and retrieval, information science. Given the scope of the problem it proved difficult to isolate those key areas that are most relevant to the problem in hand. For these reasons the literature review is still ongoing and will be available separately.

4.5 Diary scenarios of search activity amongst multidisciplinary healthcare professionals

Initial evaluation of 'Diary Scenarios' [Nielsen 1995] was conducted and proved a usable method of recording details of search activity. Data is being collected for c10 hours per week over a 3 month period logging barriers to effective access experienced by users of networked PCs in a well-equipped medical library within a teaching hospital. A simple Digital Media Usage Collection Sheet was constructed which allowed details of user characteristics, goals and actions to be recorded from observations during technical support activity in the Medical Library at Hope Hospital, Salford. Hope is a large teaching hospital of the University of Manchester and library users are from the full spectrum of clinicians and students.

4.6 Survey of healthcare staff's perceptions of search activity after receiving formal training sessions in effective access to digital research evidence sources .

Favourable reactions from some clinicians, together with a lack of any usable feedback from the majority of users led to the development of a formal questionnaire survey of a sample of health professionals (across disciplines) after they have received formal hands-on training sessions conducted by the author in effective access to digital sources of research evidence. Aims to discover changes (if any) in the user's perception of their own competence in digital searching before and after formal training sessions.

5. Findings

We have seen how understanding and attempting to overcome difficulties of effective access to healthcare research evidence is demonstrably a subject of real world importance as well as purely academic curiosity. The study is part of the ongoing wider GEMISIS 2000 programme which is undertaking research in a number of fields to discover how the new information and communication technologies can be used for the good of society.

5.1 Barriers to effective access

Clinicians and students now have to negotiate a bewildering array of interfaces to get to the information they need. Aside from the confusion of the World Wide Web, healthcare professionals have to grapple with different interfaces to what used to be familiar databases. For example, the best-known medical bibliographic database, MEDLINE is now available in a number of different formats on the WWW - both free and as a subscription service - plus the local network connection accessed via a Windows environment and WWW format. The latter two options also permit searches of many more health-related databases simultaneously. At the other end of the spectrum from problems of the dramatically increased searchspace is the still significant degree of computer-illiteracy in the health sector. Many users are attracted to the new information media who have never used a computer and/or a mouse before. Preliminary evidence suggests that this category of user appears to derive a great deal of benefit from training, and that searches provide a useful entry point to computer use.

5.2 Using the WWW to train health professionals to get over these barriers

The Salford Diabetes Centre website seems to have had a positive effect in terms of consciousness-raising about digital issues amongst staff. Similarly, the library website has proved a valuable tool in training sessions and continues to provide a handy start point for new users and more experienced searchers alike.

5.3 Health professionals' current ability to get over the barriers

With appropriate training most of the health professionals studied seemed able to overcome the barriers

to effective accessing of Web-based research evidence sources and those in other digital media. Once introduced to the possibilities of the technology, many new users returned for further experience and/or training

6. Conclusions

From the initial findings of this study it appears that there are particular difficulties involved in effective access to healthcare research evidence, but there are signs that, with appropriate face-to-face hands-on training from information specialists, clinicians and medical students can overcome them. Aside from problems of information overload there are also more mundane problems of 'computer-illiteracy' even amongst healthcare staff whom one might suppose had had plenty of computer experience.

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Implementing highly configurable Subject Trees: The ITC system

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Abstract: This paper discusses a way for automating the generation and management of Subject Trees. Based on specific needs identified by real-life projects, we introduce the "Interactive Thematic Catalog (ITC)" system. Primary design principle is the use of a database for all organizational and storage purposes. Compared to existing systems, ITC preserves several known features but also adds new ones enhancing navigation and administration. A working ITC system has been developed in the Hellenic Ministry of Culture (HMC) Web site.

1. Introduction

The general problem addressed with this work is the efficient support of cataloging resources in the World Wide Web and searching in catalogs with the use of keywords. Tools currently used in the Web fall in two main classes. The first one includes search engines and the second comprises Subject Trees or Thematic Catalogs, where the information is structured in a tree (more strictly a hierarchical structure). ITC belongs to the second class. Its primary features include usage of a database for storage/management of both content and structure, support for multilingual content, multiple categorizations, integrated administration through a simplified interface (allowing easy setup and reconfiguration), built-in optimized searching, automated page generation. Special focus has also been given to low resource requirements, portability, customizability and extensibility. Some of the aforementioned individual capabilities can be found scattered in other existing systems (see Section 5), but no other system seems to integrate all of them. ITC's primary and unique design guidelines – including multilingual support, compactness, tight feature integration, intuitive administration – are derived from real-life requirements, especially from the development of tools on HMC's Web site for cataloging Cultural Web sites. In Section 2, we describe some design features found in a typical Subject Tree. In Section 3, we briefly discuss ITC's design and outline some additional features and software integrated into ITC in order to meet the expanded set of requirements. A detailed description of ITC's components is provided in Section 4. The basic components include definition, content entry, generation, administration and searching. Conclusions are finally outlined.

2. Formal definition

A Subject Tree is defined as a set of hierarchical structures that categorize a repository of information. Each structure represents a *basic category* that has a specific context (eg. Geographical location). The top node (*basic*) points to other categories (*nodes*) which refine its meaning, and each of these categories can point to other subcategories. This process continues until the scope of a sub-category can not be further refined (*final*). Categories lying between the basic and the final are termed *intermediate*. In the intermediate and final categories, information units (*leaves*) can be "inserted". Insertion is the semantic classification of an information unit. The sets of information contained in the basic categories are not necessarily disjoint, allowing therefore an information unit to be inserted in multiple tree structures. Apart from the above classification, the categories can be defined as follows: A *Type A* category can only generate other categories, not leaves. This case is usual at higher levels of the tree structure. Basic or intermediate categories can be Type A categories. A *Type B* category can generate other categories but may also include leaves. A *Type C* category can only generate leaves and no categories (identical to final categories). It is possible that the meaning of a category (*Type D*) and all its generated categories and leaves are such that they can belong to more than one tree structures and respective basic categories. Given that the same information should not be repeated, a category can change the basic category it belongs to. Figure 1 shows the category types and Figure 2 displays the typical structure of a basic category as a Tree.

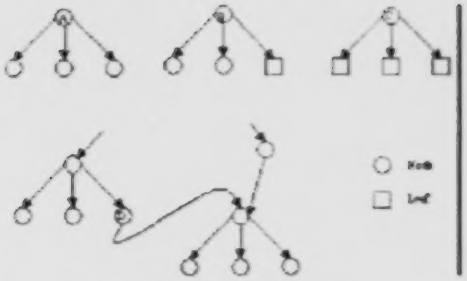

Figure 1: Category Types

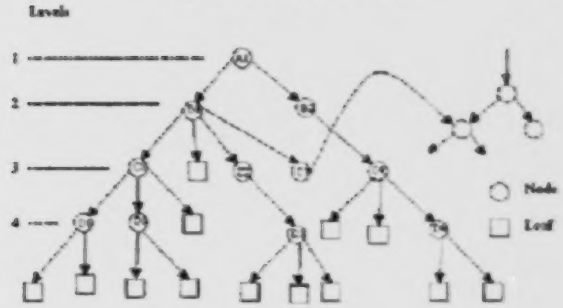

Figure 2: A typical tree structure for a basic category

In the above diagram, among the categories generated by A1, intermediate categories are B1, B2, C1, C2, C3 and C4 and D1, D2, D3 and D4 are final. C3 is also a Type D category and points to a sub-category of some other basic category. A sample Subject Tree having three basic categories (A1, A2 and A3) is shown below:

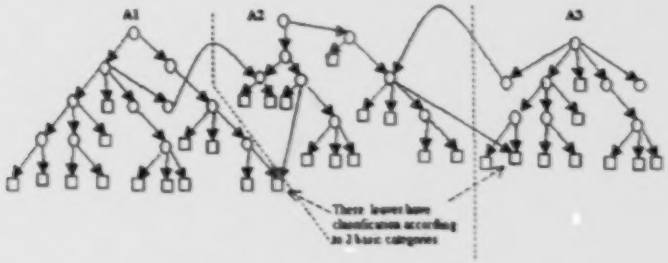

Figure 3: A typical Subject Tree structure

3. Presentation of ITC

In this section, the main characteristics of ITC are determined. ITC can be used to the benefit of both site administrators and end-users. Regarding administrators, ITC is a compact tool guiding them through the process of defining the tree's initial structure, supported languages, basic categories and content. It is an independent installable application generating content for the Web. Therefore, minimal information and no programming skills are required, a feature that differentiates it from similar commercial applications. Pages are automatically generated using pre-defined templates. However, as the system uses standard programming environments, an expert developer can customize many features, such as the appearance of the indexes' and contents' pages. This shows the system's high scalability. The interface is built using HTML forms, which has become a standard interface for managing data. After the initial definition of ITC, the administrator can update the categories' defini-

tion and structure, as well as the content. ITC provides an embedded search subsystem that runs optimally for ITC's current definition. Consequently, no external search system needs to be independently configured. Searching can be either restricted to a certain sub-tree or not. In addition, the code for authenticating users wishing to update ITC is embedded in the system. From the users' view, the implemented ITC system offers some functions not normally found in similar tools. For instance, data is organized and presented in such way that users can browse and search information sorted by various criteria according to defined basic categories and can easily jump among different levels of the classification. Furthermore, ITC supports switching between different language versions (declared by the administrator) of the same content. Thus, users can view the content in the language they prefer and, anytime, they can switch to the same page of information in some other language.

Technically speaking, the declaration of the languages to be supported occurs at the beginning of the generation process, described in 4.1. The system's structure in the form of categories and translations of terms in other languages is stored in a *database* that also stores the leaves' content in all defined languages. For each basic category, there is a separate table storing information about its subcategories (definition in all supported languages, type and their inter-relation). Each basic category can easily be mapped into a relational database table.

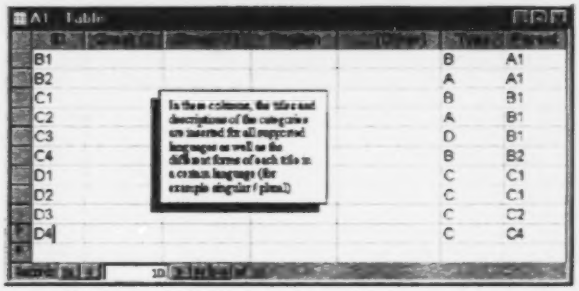

Figure 4: Database table representing a basic category's structure

Figure 4 shows an example for the A1 basic category. In this table, there is one record for every category storing an ID distinguishing the category and showing its position in the tree structure and fields recording the category's Type and Parent Category in the hierarchy. An auxiliary field (automatically set during definition) is defined that accelerates searching, as it helps pre-computing most of the code needed. Finally, there are fields storing the category's title and description in all defined languages. If necessary, there are more than one expressions of the title for a certain language. The number of supported languages is not limited. The content of ITC's leaves (title and description in all supported languages, classification) is stored in a central table as shown in Figure 5. The table corresponds to Figure 3's typical ITC. There are three basic categories (A1, A2 and A3), as many as the table's fields. There are fields for code, URL, titles and descriptions in all supported languages and category codes for classification in every basic category. ITC is a specialized system, suitable for describing highly interrelated content. This justifies the definition of a separate table for every basic category. The fact that the database stores both structure and description of the categories helps in automatically generating the pages.

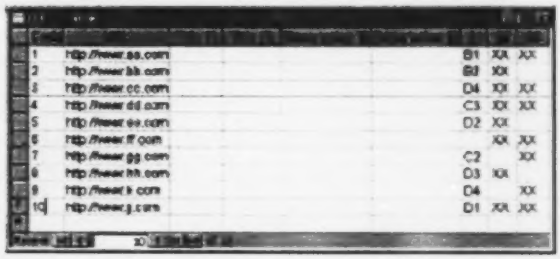

Figure 5: Central ITC table

The system follows the basic guidelines of RMM [Diaz 1995]: There are distinct steps for designing the structure (categories), populating it (leaves) and displaying it (multiple views). A transition between different steps is possible too. For the working system, we used Visual Basic for generating the static pages. Java

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(www.javasoft.com) was used for the Web-DB interface. Microsoft Access and SQL Server were used for storing data, but any DBMS from which data can be exported is suitable. The HMC's ITC system is in www.culture.gr/7/index.htm. This ITC stores information units about Cultural Sites in the Web. Searching and adding content are enabled, as well as toggling into other languages.

4. ITC's Components

In this section, ITC's components are described. They are implemented in HTML (enabling remote configuration). A definition component is provided for constructing the system's structure. This component generates also the content entry component, so that data entry can begin. The generation component produces ITC's HTML pages. The system's structure and contents can be updated using the administration component.

4.1 Definition

The component's execution begins by defining the names of the languages and basic categories. A new database is built containing the automatically generated and appropriately structured central and basic category tables. The administration and content-entry components are then automatically generated. The administration component is used for both initial definition and restructure of subcategories (explained in 4.4). These operations use the same form (see Figure 6). The form contains a menu listing the already defined non-final categories, sorted by depth. It also contains fields for entering a sub-category's information in every language and its type. In Figure 6, a certain stage of the input process is shown, assuming two languages. Particularly, the user inserts a subcategory in the A1 basic category. In order to insert a new category named D1 as C1's child, a user supplies the category's translation in the defined languages, chooses C1 from A1's menu and clicks "Update A1".

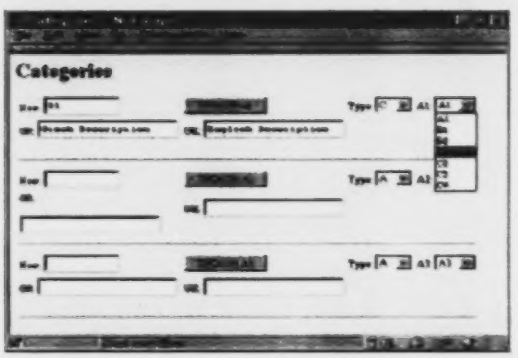

Figure 6: Category input and update form

4.2 Content entry

After the definition of ITC's structure and hierarchy, the next step is to insert information units, the leaves of intermediate and final categories. The user may either navigate using hyperlinks in order to choose a category for a new leaf to be inserted, or choose appropriate categories using category menus. The necessary form is automatically generated during the definition process. There is a menu for every basic category. Having selected the basic categories the leaf will belong to, the user should provide the leaf's description in all defined languages. For every new leaf, a record is inserted in the central table. After the insertion of new leaves, an incremental regeneration of ITC is performed, except for the first time (when full generation is needed).

4.3 Generation

This component's role is the generation of ITC's static content pages from the database (These pages can be

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dynamically generated as well according to specific needs). For a given language, an introductory page is created containing hyperlinks to every basic category. Then, for each basic category a page is created containing hyperlinks to its direct children categories. The same procedure is repeated for subsequent levels. A category's page contains links to its children categories. In this way, a fraction of ITC is generated, corresponding to the basic category's structure. The category codes have such values that help in the hierarchical top-down page generation. The algorithm that generates ITC operates in such a way that allows a category's page to appear only when this category or one of its children categories has at least one leaf - descendant. Therefore, an administrator can define the structure of the ITC hierarchy independently of its leaves' contents, which improves the system's flexibility. There is a procedure for generating a category's subtree defined by its children categories and one that generates pages concerning a category's leaves. The latter runs for a specific category and generates information for every leaf belonging to the category (Title, description, URL, classifications). Possible sortings and links to classifications according to other basic categories are also included. In case of a Type B category, there is information pointing to its children categories and information about the leaves belonging directly to the category.

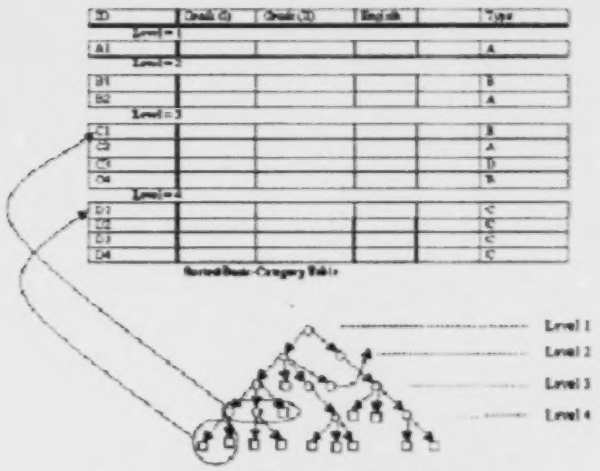

Figure 7: An instant in the generation process

Figure 7 demonstrates a typical generation process using Figure 2's A1 basic category. Two instances of the procedure are shown. The generation takes place in levels starting from the tree's root, traversing intermediate categories and reaching the final ones. During level 3, for instance, and particularly for C1, a page is generated containing hyperlinks to its two children, and providing information about the leaf belonging directly to C1. At the end of the generation process, the necessary code for searching is also generated. As ITC supports multilinguality, hyperlinks can be inserted in every page pointing to available translations of the same page.

Consider an ITC with "Geography" and "History" as basic categories. During the generation of "Geography" category, a path for leaf "Knossos" could be Geography->Europe->Greece->Crete->Knossos. Thus, Knossos will appear in Crete's page. As Knossos is a classical archaeological site, it will also be classified in "History" as History->Archaeology->Classical->Knossos. Therefore, it will be contained in "Classical" page. So "Crete" page will state that "Knossos" is classified as "Classical" according to "History" with the appropriate hyperlink and "Classical" will state that it is classified as "Crete" according to "Geography" with a hyperlink to "Crete".

4.4 Administration / Searching

The initial use of the component is described in 4.1. Afterwards, there are two kinds of maintenance procedures available to ITC's administrator. First, the contents of ITC's leaves may be altered or deleted, with the aid of a form. There can be a change either on a leaf's title and description, or its classification according to the basic categories. A complete administrative sub-system has been implemented allowing system maintenance through the Web. The necessary code is generated during the generation process. After changes are completed, there is an update phase where only pages containing leaves whose content has changed will be generated again. The final part of the Web interface consists of a form that lets an unskilled user add new leaves in the system. The

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structure of subcategories can also be changed. The administrator can define new categories through a form (described in 4.1), delete others or update a category's information (description, parents, children). Data consistency is always enforced. In addition, a new generation of ITC is needed in order to reflect the new structure.

Finally, in every level, searching is integrated allowing the user to perform queries on the whole tree, or on the sub-tree of the category currently being browsed. The process runs optimally for the currently defined set of categories and content, due to the way categories are defined. The form used is similar to that of content entry.

5. Related Tools

Most relevant to ITC is Yahoo (www.yahoo.com), which covers basic features of a Subject Tree, allowing hierarchical views of nodes, searching in subtrees and addition of leaves. LivePage (www.livepage.com) enables importing pages from Web sites and relational databases and makes use of their structure in order to produce navigational structures. Netscape's Compass Server (www.netscape.com) enables the automatic construction and searching in hierarchical catalogs. BOTH [Angelacio 1996] merges search results from various engines and presents them in hierarchical categories. The system proposed in [Poulin 1995] enables the construction of hierarchical catalogs by using specially formatted abstracts provided by users. Rosetta [Tripp 1997] is a pool of educational resources stored in a database and classified hierarchically in browsable categories. The Integrated resource Query and guided Browsing System (IQBS) [Wu 1996] helps acquiring and classifying information on Web pages and supplying browsing capabilities to the end user. Self-running robots are used and acquired resources are automatically classified in hierarchical categories according to constantly refined decision rules. In [Mukherjea 1995], "Navigation View Builder" is presented by which a graph of hypermedia nodes can be converted to multiple, hierarchical, tree-like structures according to certain criteria. Finally, in LINCKS (www.ida.liu.se/~lincks/), composite objects containing raw data, attributes and links, are instantiated in multiple views using Presentation Descriptors. Versioning of objects and collaboration between users are also supported.

6. Conclusions

A system is presented supporting the automated generation and management of Subject Trees. It preserves the typical known features of other systems and, in addition, it satisfies increased requirements mainly imposed by practical considerations. It offers multilingual support, multiply categorized hierarchies, customized and fast searching and full Web-based administration features, so that users having no programming skills may build their own system. The system's flexibility and ease of use has allowed us to generate Thematic Catalogs covering various knowledge domains with minimal effort and time. We are currently working on extending ITC's structure so that a site administrator can build multiple views of Web sites, index pages, maps and guided tours.

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Distance Education Genres

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Abstract: Information Technology enhances the possibility for people to communicate when separated in time and space. In Distance Education this means new tools for tutoring and collaboration. But what effects does IT really have on the interaction between students and teachers? This paper presents some results from an ongoing study of a distance education project at the University of Trollhättan Uddevalla (HTU) in Sweden. The study focuses on the different types of electronic interaction that takes place within this setting. The analysis of the interaction is based on Genre Theory and identifies three

1 Introduction

The Internet and other electronic media have had and will have a big impact on all types of interaction. In order to understand these new interaction-phenomena one must bypass the rather vague and blurred manner in which the word *Interaction* is used, reducing it from a hyped buzzword to a well defined term [Jensen 1997]. In studies of interaction with respect to Distance Education, [Paulsen 1995] emphasises on the number of 'interactors' to create a taxonomy of different pedagogical techniques in Computer-mediated communication. [Moore 1993] distinguishes between three different kinds of interaction, with respect to the roles of the persons involved, (learner-content, learner-instructor and learner-learner).

An approach that incorporates the media and audience as well as substance, structure and language of the interaction is Genre Theory. Originally the term *Genre* was used to classify literary works of high value [Reimer 1994]. Over the years this has changed, and in the works of [Orlikowski and Yates 1994] it is used to describe patterns in organisational communication. They define a genre to be *a Typified communicative act having a socially defined and recognised communicative purpose with regard to its audience.*

In their study of email-interaction within a community of geographically dispersed knowledge workers, they found that the properties of a genre are strongly influenced by the experiences and expectations that exist when the community is formed. [Shepherd and Watters 1997] who studies the evolution of 'Cybergenres' reach a similar conclusion. They argue that when an existing genre enters the Internet, it is replicated from its origin, despite the change of medium. This paper presents some preliminary result from an ongoing study of a distance education program at the University of Trollhättan Uddevalla (HTU) in Sweden. The study focuses on the different types of interaction that takes place within this setting. Using Genre theory I want to identify typified interaction patterns. The data concerning email interaction has been collected from the teacher's mailboxes at home and at work. The number of visitors to the Debate Board as well as the entries has been logged. The data analysis is based on the framework for coding used by [Orlikowski and Yates 1993]. Each email and debate board entry is analysed with respect to purpose indicators (primary and secondary), structural indicators and language indicator (humour, sarcasm and informality). Results so far indicate three fairly distinct genres. (Query, Feedback and Smalltalk).

2 Background: A crusade to the academic outback

HTU is situated in a region of Sweden with the lowest degree of academic education. Several actions and political initiatives have been taken in order to increase the number of people proceeding to higher education. For example, all communities in the region have invested in videoconference studios and there are ongoing

projects aiming at providing fast Internet-access for more people and companies. The subject of the study presented in this paper is the SYDUB -project, where students in six small communities can take a B.Sc. in System Analysis via distance education. The first course started in January 1998. It was a ten-week course in Mathematics and Statistics, using primarily videoconferencing and the Internet as education-channels. The Web Education is done with the help of a system called DisCo. This system has been developed at HTU and is a framework for all course-related activities where teachers and students can publish documents into a hypertext structure with support for navigation and interaction. The interaction is primarily facilitated through an email function and a threaded debate board. For a more detailed description of DisCo, see [Svensson and Ekenstam 1998]. The use of videoconferencing forces the students to meet face-to-face when attending lectures and seminars. This is backed up by the fact that the course immediately started with a group assignment. This was done under the assumption that social bonds could reduce the high dropout-rates often reported in Swedish distance education projects [Ahlén 1997].

3 Preliminary Results

A total of 165 email from students to teachers, sent during a period of four weeks in January and February has been examined. During this period there has been 110 entries made on the debate-board, divided into 48 different discussion topics. The number of student-visits to the debate board where approximately. The results indicate that three genres can be identified., presently labelled Query, Smalltalk and Feedback. All is existing both in the email interaction and on the Debate Board. Below are some short characteristics and examples (translated from Swedish) of each genre.

Query: (ca 70% of email, 20 % of debate entries)
The purpose is in mostly oriented towards help with exercises and clarification of textbook examples, (a secondary purpose is fairly common). A personal-structure with friendly opening salutations and closing remarks occur in most cases. The language is often informal, but seldom humorous and never sarcastic.
(Email example)
Hi there Mr Math Yet another question from Tanumshede. In chapter 13 there are some confusing remarks on randomness. Is this something we should dig in to, (there was nothing in the study guide about this).
Have a nice day, we surely do, Fred

Feedback: (ca 20% of email, 30 % of debate entries)
Positive feedback was mostly on course material, videoconference-lectures and thanks for quick responses to email questions. The negative comments were dominated of technical errors (web-server, videoconference) and complaints about the study-pace. But also constructive propositions were given. Messages were personal and friendly (especially in negative feedback) but sometimes anonymous. Several examples of 'multiple-rounds-email' occurred (sent back and fort between teacher and student). The genre with the highest rate of 'smileys'.
(Email example)
Comment: Thanks for a very good lecture (980203), but you were a little to quick for me in the end (sigh). It would be great if we could have a file with the calculations you made. Kind Regards Andrew H

Smalltalk: (ca 8 % of email, 50 % of debate entries)
The purpose is to entertain and socialise, sometimes with a touch of 'for-your-information..'. The content is often related to some course activity. Often anonymous or signed with pseudonym. Nearly always humorous and sometimes sarcastic
(This example, from the debate board, is somewhat shortened)
New Super-Computer to the University of Lund, what do you say about that - Uddevalla? This spring a new super-computer will be installed in Lund. It will be one of Sweden's three fastest...For those of us who loves numbers ..it will consist of 100 processors, 300 MHz each, 24 GByte RAM and 582 GByte disk and will have a top speed of 60 GFLOPS..... one can't help wondering when are we gonna get that kind of brute force on our desktop? What about the situation in Uddevalla? Can you match this or...?

Some general comments on the difference between the email and debate versions of the genres is that the language tends to be 'better' and more worked through in debate entries, probably due to a bigger audience.

Practically all Debate-entries had only one purpose, whereas over 30 % of the email had two or more. Sometimes a message in the question genre was both posted on the board and sent as an email. Studying changes over time indicates that the number of Smalltalk entries increased at the end of the period, and feedback entries decreased. The total number of emails and debate board entries were approximately the same each week. The amount of data collected and analysed are too small to base any strong conclusions on. The qualitative result presented above will serve as a basis for more thorough analysis that very well can lead to different clustering and redefined genres.

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Moving Usability Testing Onto the Web

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Abstract: In order to remotely obtain detailed usability data by tracking user behaviors within a given web site, a server-based usability testing environment has been created. Web pages are annotated in such a way that arbitrary user actions (such as "mouse over link" or "click back button") can be selected for logging. In addition, the system allows the experiment designer to interleave interactive questions into the usability evaluation, which for instance could be triggered by a particular sequence of actions. The system works in conjunction with clustering and visualization algorithms that can be applied to the resulting log file data. A first version of the system has been used successfully to carry out a web usability evaluation.

Introduction

Usability testing is a difficult and costly process. One problem is to find subjects willing to take part in the experiments usability engineers set up. Another is to actually perform the testing, an often time-consuming and costly process. Once the data is collected, yet another problem is to analyze the collected data on user performance and draw conclusions from the result. These problems are far from the only ones involved in usability testing, but they constitute major drawbacks that make most software developers reluctant to actually perform them.

In a project named Traces, we have tried to tackle these problems through building a "usability laboratory" that will work remotely over the Internet. We want to test the usability of web pages, and, in an extension we see the possibility of testing other interfaces built using Java or other tools that allows for more interactive interfaces.

Our approach has been to support the usability engineer in several steps of the test cycle. First, early on in the design cycle, the usability engineer might want to try out ideas using a 'Cognitive Walkthrough' or 'Heuristic Evaluation' method [Lewis C et al. 1990; Nielsen and Mack 1994]. This can be done through putting some mock-up pictures on the web and then have experts evaluate the design through using our tool. Later in the design, before putting the system out on the market, end users can be involve in a controlled study [Holyer 1993]. The tool then needs to log users interacting with the system, perhaps posing some questions to them before, after or even during use. Finally, once the system is in use, user feedback can be obtained on how to improve the system through questionnaires.

Our idea is simple and straightforward: to build a logging tool that can access all the 'events' that takes place in a web browser and that can interact with the user at predefined junctures in order to get explicit feedback. When we turn to the web, we gain access to many users, thus we avoid some of the problems involved in finding users that are willing to spend time on testing software. Also, users can perform the test at any time or place they find convenient. This reduces the need for laboratory testing thus tackling the second problem mentioned above.

Unfortunately, logging events over the web will not avoid the problem with long logs that the usability engineer has to analyze. Depending on what you decide to log, you might end up with very much data. Our approach to solving this is to look at various methods, such as statistical, demographics, or clustering methods,

and combine them with visualization tools such as Spotfire [Ahlberg and Shneiderman 1994a; Ahlberg and Shneiderman 1994b] and HyperSpace (http://www.cs.bham.ac.uk/~anp/haiku).

In [fig. 1] we can see the kind of scenario we envision: first the usability engineer sets up the design to be evaluated, then the Traces logging tool collects data on how end users or experts go through the interface (commenting or just logging or both), and finally we present the obtained data using various tools and methods.

Depending on how advanced the interface to be tested is, we can catch various different usability problems. Examples of usability problems we can catch are:

- structural, navigational problems,
- design of graphics, icons, text links, etc.,
- anticipations, attitudes, and appeal of the interface.

So to summarize our tool has to:

- catch user events
- enable the usability engineer to decide which events to catch for a particular study
- keep track of the time when an event occurred
- be able to receive comments from the user/expert and be paused
- preserve the original interface of that being tested

Let us start by describing our implementation, and our ideas for visualization. We then describe an experimental study performed using our tool. Finally, we summarize and discuss future requirements on this kind of usability testing environment.

Implementation of Traces

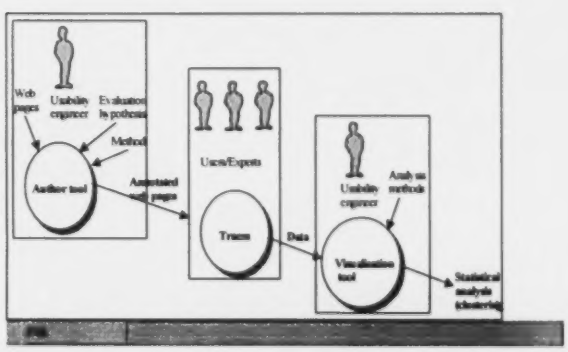
Starting from the requirements outlined in the previous section, the Traces environment was developed. The Traces environment is a two-component tool implemented in Java and JavaScript. The first component allows designers to annotate web pages and the second logs users' actions. That is, when a user enters a site, prepared for Traces, our tool logs every event that occurs inside the web pages in that site. Let us start by describing the logging tool.

Communication between Client, Traces, and Server

HTML the standard for web-content, is constantly changing. The different browsers offer all kinds of functionality, such as event handling, security restrictions, etc. Although Traces is designed for Netscape the intention is to present a solution that can easily be extended to other browsers and conditions. Thus, it is important to make Traces as general as possible. Traces must:

- make no assumption on what browser it is supposed to work with,
- make no access to the HTML-pages it is going to log, in effect, accepting any version of the HTML language and all browsers that support it.

This means that Traces can not derive any information from the HTML-pages, nor can it rely on any browser specific information. That is, Traces has to be an autonomous program that the annotated web pages can send messages to. To achieve this, applets, JavaScript and frames were used. The annotated web pages contain JavaScript that send messages to an applet, Traces, that in turn time-stamps the messages and sends



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them back to the server. The browser window is divided into two parts – using frames – one that contains the applet and one that contains the annotated web page. This way the applet is kept in the browser rather than loaded with each new page the user enters.

Using two frames solves another problem. We need to introduce some control and comment fields to enable users to start and stop the logging, make comments, etc. We decided to add this information to the frame containing the applet, since it needs to be visual all the time. However, this information can be removed to fit with the usability testing situation.

Event Handling

It is necessary to catch user events and store these in a readable fashion. We have to be careful in selecting user events; the amount of collected data can very fast grow out of proportion. Recording low-level user events, such as keystrokes, produces vast amounts of data, and the method is thus usually discarded when evaluating user interfaces. As stated earlier Traces must allow the usability engineer to decide which events to log.

Most browsers have an event handling mechanism that executes JavaScript code. Different events trigger different parts of the JavaScript code. For instance, when a user clicks on a link a handler could be triggered and send the message "link hallo" to Traces. Event handlers are easy to implement and Traces does not need any knowledge about the browser. All communication between Traces and the HTML-pages is done through JavaScript code added to the HTML-pages that sends messages to Traces.

Authoring environment

Now let us turn to the second component of our tool, the authoring environment. Traces does not retrieve any information from the HTML-pages or the browser. All events are sent through JavaScript from the HTML-pages to Traces. This limited communication means that the detailed information about an event must be included in the messages sent from the HTML-pages. So in order to annotate a web page, the usability engineer either has to be skilled in how to produce JavaScript code that sends back the right kind of information to Traces, or we must build an authoring tool that supports the editing and making of new annotated web pages. The latter is to be preferred, but places the following demands on the authoring environment:

1. It must assist the usability engineer to create annotated web pages. Depending upon method used and stage reached in the design life cycle, different kinds of logging will be needed. In a site that contains hundreds of HTML-pages it is crucial to be able to quickly change the HTML-pages for different kinds of studies.
2. It should help the usability engineer to set up questionnaires and pop-up questions.
3. It should preferably have knowledge enough to be able to recommend to the usability engineering what an appropriate message to Traces could be. An HTML-page contains many properties that can be accessed through JavaScript, out of which only some are interesting in a particular situation.
4. It should support general guidelines on how to set up a study using the different usability testing methods available.

So far we have only implemented an authoring tool that addresses the first and second issue. The authoring tool allows the usability engineer to specify what events are to be caught and what messages are to be sent to Traces. Furthermore the designer can create pop-up questions or surveys that will appear in specific web pages. The authoring tool then parses one HTML-file or a directory structure and produce new HTML-file(s) that supports Traces, i.e., the new HTML-files contains JavaScript event handlers that call the Traces applet.

Related Work

The idea of using WWW as an environment for usability testing is not new. Catledge and Pitkow [Catledge and Pitkow 1995] captured client-side user events through creating a new version of Xmosaic. Their tool differs from ours in two important ways. First, they had to implement a specific browser. Second, their tool was passive, in the sense that it did not allow for any interaction with the user apart from start-up question that informed the user about the logging. Even if their technical solution was not optimal from our perspective, they did show that it is possible to get useful data from capturing user events, both in terms of identifying browsing strategies, and making design improvements.

Chang [Chang and Dillon 1997] use a slightly different approach when they move the usability laboratory to the users. Their program work as a component in the user's machine, allowing them to catch every event in the system. Thus, Chang and Tharam are not restricted to the interface that is to be tested, but they can also monitor what is going on outside the interface.

In addition there are a large number of tools that collect statistics, such as, how many hits a web page has, what machine accessed the page, and what pages the user visited before she accessed the current page [Pitkow 1997]. These tools are frequently used for marketing purposes but in some cases also used for usability purposes [Brown and Benford 1996] and WebVIP (http://zing.ncsl.nist.gov/~webmet/vip/webvip-process.html) or other purposes such as Footprints (http://wex.www.media.mit.edu/people/wex/Footprints/footprints1.html). We believe that there is a need for tools that go beyond the logging of "accessed" web pages. It is also important to catch what is going on within a web page, and also to have the ability to interact with users by, for instance, pose pop-up questions to them. So basically what makes Traces unique:

- the ability to create continuous logs of each individual user's session in a site,
- the possibility to log all or just some events that a browser allows for,
- the possibility to create interactive questionnaires and pop-up queries integrated within the web pages, where the answers from the users are integrated with the logs obtained.

Visualization and Clustering

As mentioned previously, Traces can provide us with long and detailed logs of user behavior. These need to be analyzed when we establish usability of a site. Since our approach is to provide a fairly general tool for usability testing, it will not be possible to find one single tool that can perform all sorts of statistics needed. Instead we need to find combinations of visualization of data, statistical analysis, clustering, etc. that each contribute to the analysis.

In our first study, we have devoted attention to the following usability areas relevant mostly to web site design:

- navigational tools
- browsing flow and space
- the connection between demographic data and user behavior

Below we discuss the study and how each area can be dealt with using available tools and methods. We do not want to claim that we have found general usability guidelines for the design of web pages – rather this exercise is meant to convince us that Traces can provide the usability engineer with relevant information and that this information can be analyzed through a combination of tools available on the market.

Test study

Our study was performed on a subpart of the site Passagen(http://www.passagen.se). The subjects were students in computer science and cognitive science. They were asked to comment on their actions by typing remarks in the logger's visual interface. They were also asked to provide additional demographic data, such as gender, age, level of browsing knowledge, and address. The subjects then performed three predefined tasks:

- To find a particular link somewhere in the site, click on it, and then return to the main page.
- To find a link that leads to an article, and then browse around this article (consisting of several pages) until they were satisfied.
- To follow detailed instructions leading them step by step through a number of pages.

These three tasks reflect three different situations: a search situation, a browsing situation and one control case allowing us to verify the logging tool.

We received about 60 log-files, out of which, in the end, only 33 were used, since the tasks had been fully completed in them. We made the decision to not include the incomplete logs in our statistical analysis mainly due to the fact that we could only guess the reasons for the participants to not complete the tasks given to them. However, this large dropout rate tells us something about the logger when doing these kinds of studies. The tool has to be totally reliable in order to rule out that the cause for the uncompleted logs is not due to any malfunction in the logger. 21 male subjects and 12 of female subjects participated. Among the men, 9 considered themselves to be expert web users, 7 good and 5 intermediate users. Among the females only 2 considered themselves to be experts, 4 good and 6 intermediate. The fastest subject completed a logging in 16 steps (1.27 min-

utes) and the slowest in 38 steps (12.32 minutes). The average value was 24 steps (5.41 minutes) and the median value 24,2 steps (5.52 minutes). The oldest person in the study was 44 years old and the youngest 21.

Site Structure Analysis

Depending upon content, task, targeted user group, etc., a site's structure can be organised differently to be most efficient and usable. In general, a site should be well balanced and have its information *structured* in some kind of intuitive *hierarchy*, e.g. a balanced tree structure were different branches in the tree contain different topics [Nielsen 1993; Shneiderman 1992; Shneiderman 1997]. It is also important that the site has a good level of *connectivity*, i.e. number of links between pages. Again, the correct grade of connectivity can not be determined through any general standards, but must be decided from site to site and from page to page depending on the information content, users, etc. Index pages may contain numerous links, while pages with text documents may not have any links at all.

We used Hyperspace to examine a site's structure and connectivity. This tool is a dynamic, self-organising interface for real-time data mining. As a user browses through web pages in the browser, Hyperspace creates a 3D molecular like structure of the pages. In this structure spheres represent pages, and lines between the spheres represent links on a page leading to another page. The structure can be turned in any angle and the user can zoom in and out.

The model generated through interacting with Hyperspace was then examined in terms of structure and connectivity. Both the site as a whole and subparts of it were examined in this way. From these models we found that the site had a flat tree structure which would indicate that it is easy for the users to orient themselves, but on the other hand, there were some confusing links that lead several steps down in the hierarchy. These links were no doubt meant to be highlighted shortcuts (which could be a good idea) but they tended to be rather confusing in this context.

The connectivity of the site was in general good, apart from one subpart lacking connections with any of the main pages. This means that it will be difficult for users to jump back to the main page of the site, thus leading to orientation problems.

Browsing flow and space

It is useful to examine users' browsing behaviour in order to find design mistakes. For example, it is valuable to know if users are aware of various possible links from a page, e.g. buttons, text, menus etc. If not, we might need to redesign such icons or text links or the general site structure.

In order to understand our targeted user group's browsing behavior, we followed and analysed the subjects' actions by stepping through the log-files for the first (search) task in our study (see above). First we followed each user's path with Hyperspace to create a model over the site that the user had visited. This model was later compared to the complete structure of the site and models from other subjects performing the same task. By comparing these different models we found that about 60% of the subjects moved in almost exactly the same space in the site and almost all of these found the direct link to the target page that was located on the main page.

With use of Spotfire we then analysed each subjects' path through the test web site. Spotfire displays data in a multi-dimensional graph space that can be manipulated interactively.

By selecting time on the x-axis and link steps on the y-axis, see [fig. 2], we got a clear picture of how much time was spent on each page.

From analyzing the whole group of subjects, we found that most users had a "slow start" but then moved fairly quickly from page to page with an average time on each page of 5-10 seconds. As with Hyperspace we could see that most of the users found the correct page and that they kept to almost the same set of pages. We also discovered that the different users needed very varied amounts of time to complete their tasks. Subjects spent from less than two minutes to more than twelve minutes to complete the first task. Completion time was later checked against the subjects' age, gender, and experience but no definite conclusions could be made due to the small amount of subjects.

Orientation and link types

The next issue to examine is the subject's understanding of the available navigational aids, such as menus, icons and textual links. We examined how subjects navigated in the test site and which kinds of aids they used. On many of the pages in the site – especially those in the top layers – there exists homogenous, graphical navigational bars with links that can take a user to the main page, to the main sub-pages, to a search page and to a contact page. On some pages the same links are displayed both as text and graphics.

For example, for the particular subjects' behavior displayed in [fig. 2], we can see a pattern where several "dark" (Spotfire displayed as "blue dots") follow quickly after one another. These are in fact "back"-button events, and shows how the user has read the article and is now trying to return to the main page. Since there was no direct link back to the main page, the "back"-button had to be used: an example of a potentially bad design. This user, and most other in our study relied more on the back-button than on the orientation links on the pages to get back to the main page. Quite a few subjects first used the back button until they arrived at a page with an orientation link that could take them to the main page; no-one solely used links. This could depend on various things such as a sense of more familiarity and trust in the browser's interface or a bad design or location of the pages orientation interface.

An analysis to differentiate user preferences for text or icon links revealed an interesting pattern which reflected page and site design. We performed an X^2-analysis in which we looked at series of link usage. We distinguish between the following user actions: a) user follows a text link if only text links are available - T - or if there is a choice between text and graphics - T(G); b) user follows a graphical link with only graphics available - G - or when there is a choice between text and graphics G(T); c) user uses back button B.

In [table 1] the data are tabulated by adjacent link choices: the x-axis represents the user following a link, and the y-axis the *NEXT* link followed. Thus, for example, we see from the table that there are two occurrences of first choosing a graphical link on a page that has both text and graphical links, and then choosing a text link an a page that also has both has text and graphical links (i.e. the "2" in the third column and second row of data).

Table 1: The X^2 matrix for user X.

The X^2-analysis (on the entire matrices, or on subsets of them) revealed with a 97% probability that most subjects did not choose to follow only text links or graphical links. Instead they switched between the two repeatedly by for example first taking a text link, then a graphical link, then a text link again etc. This result seemed somewhat surprising at first but could be explained by the structure of the site and the design of the pages in the site. The pages contained different amounts of text, which sometimes meant that the navigational bar was placed so far down in the page that the subjects had to scroll to it. To further investigate why users choose a specific link type over another on a certain page, we looked at the main page which has several double-links, i.e. two differently looking links – one text and one graphic – leading to the same location. The results here were about the same as in the X^2-analysis – the subjects seemed to be using both of the link types.

Connecting demographic data to user behavior

If demographic information about the subjects can be obtained, it can possible be linked to the behavior of groups of subjects. This in turn means that we can understand why certain user groups behave differently and possibly create better designs to fit them

Our demographic data (including the subjects' gender, age and knowledge of browsing) provided us with a good base for clustering different groups of users with respect to their behavior. We examined, for example, how fast the different groups of users completed the tasks and if they used any special browsing technique. Our group of subjects was small and homogenous, and did not give us purchase to infer statistically significant differences between categories of users, but this area shows promise for further investigation.

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Usability issues not covered

Numerous other usability issues could potentially have been included in our study. For example, see [Burger and Jackson 1997], list a number of usability problems related to the appeal of a web site. These kinds of 'soft' issues will not be captured by logging user behavior alone, but in combination with asking the user (through using the interactive querying mechanisms of Traces) what they expect or how they react to various aspects of the interface, some of these 'soft' issues can be caught.

Summary/Conclusions

Usability testing must be altered to fit with the rapid pace by which applications are developed (sometimes collapsing the whole software development cycle into one step). The proposed Traces environment enables us to perform studies rapidly with large amount of distributed users in their regular work environment. The advantage of Traces lies in its ability to produce continuous logs of user events and possibilities to interact with the user in various ways during a test-session. Usability issues addressed are navigation, design, and subjective feedback.

What have not been discussed here are the privacy issues: when we make it possible to log each user in detail, we can also imagine various not so user-friendly scenarios. Our tool might very well be abused to check on how well users perform their work tasks, direct advertising to them that they have not asked for, etc. While we recognize these problems, we still find the strengths of this approach to usability testing to outweigh the potential dangers of misuse of the tool.

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Web Education for those who don't know how but want to, and for those who know how but don't want to.

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Abstract: The World Wide Web is a great medium for distance education, but it can also be tough to master. To create and maintain a good hypertext-system for a distance-course can be a truly time-consuming task that requires a lot of computer know-how. Many teachers lack the knowledge and/or is reluctant to spend the time necessary. This paper presents a system designed as a framework for using the www in distance education. The system (DisCo – Distance Courses) aims at helping teachers with their basic needs for using the web to publish course material and to communicate with their students, thereby inviting both those who do not know how to as well as those who do not want to.

1 Introduction

Internet technology provides a number of properties that would be tempting for most teachers to incorporate in their courses. Especially this would apply to distance education, an area where the Internet is becoming the dominating media. The possibility to arrange course material in a hypermedia structure, provide students with interactive educational software and communicate with students via email and online-conferences are some of the things that could be facilitated. Using the Internet to its full capacity is hardly an issue for most teachers. Instead it is a question of more basic needs like the wish to publish text-based material and tutor students. Already these simple needs can prove to be difficult enough to make a teacher hesitant in setting up a web site for his or hers distance-course. One obvious reason is the lack of computer/technology skills. Others who know how to create a well-structured course-site are put off by the fact that it takes a lot of time to maintain it. There is therefore a risk that a course site will be ill structured and poorly maintained. In this paper we present a system, aimed at overcoming both these obstacles.
The ideas originally evolved from the author's own time-consuming efforts to create maintain and administer web-sites for campus-courses. Working with three or four 'DisCo-courses' simultaneously surfaced the problems that Ljungberg and Sorensen calls Interaction Overload [Ljungberg & Sorensen 1998]. Several experiences served as triggers for wanting to create a system for web education, some of them listed below.

1. Adding new documents to the site involved re-coding existing web-pages. (When more than one teacher is involved in the course, there are problems updating the same file simultaneously)
2. When giving several courses at the same time it is hard to separate incoming email. (Students tend to forget to tell which course they are taking, which makes it hard to answer questions like "When is the assignment due?" or "Can I have the study Guide for chapter two in Mac-word format, please?")
3. Problems with submission of digital documents. (Sixty students sending email with an attached file called exercise1.doc)

At the same time two distance-education projects where initiated at the University of Trollhättan Uddevalla. Both these projects would involve teachers that had little or no experience of web authoring. This fact was the final trigger, and we started working on the system in January 1997. A first prototype was taken in to use in March the same year. In the first list of system requirements we attempted to address both the issues of non-internet skilled teachers as well as the time saving aspects of maintenance. The system should be able to:

- Support the possibility for teachers to publish documents, created with software-packages of their own choice.
- Provide a flexible, user-friendly hypertext structure that was easy to navigate.
- Ensure that hand-ins and email from students were well documented
- A small set of general actions are used to maintain the course-site
- No programming skills are required for the course-provider.
- All functions in the system can be reached over the Internet through a standard web browser, eliminating the need for the teacher to be present at school.

The system has been used as a distance-component in eight campus-courses since the start in 1997. In January 1998 the SYDUB-project started, where DisCo was tried for the first time in a distance educational setting. Ever since the start, both students and colleagues have been helpful in evaluating and improving the system This evolutionary approach [Dahlbom & Mathiassen 1993] to system development has implied many changes to interface and functionality. For instance, the original set of images used for navigating the system was at one time replaced, due to complaints from students using slow modem access.

2 Student Interface

Interaction is a buzzword with no strict definition [Jensen 1997]. But attempts to define the word from an educational point of view have been done by [Moore 1993] who distinguishes between learner-content, learner-instructor and learner-learner interaction. [Poulsen 1995] presents four pedagogical techniques for computer-mediated communication that focuses on the number of interactors (One-alone, one-to-one, one-to-many, and many-to-many). These categorisations can of course be useful in discussing the different kinds of interactions supported by the DisCo-system. However neither of them guided us when deciding on how to divide all course-related activities into the categories that were to form the basis of the hypertext structure of a course-site. Instead we took a more practical starting point, , focusing on the initiator of the interaction. We choose to use four main categories; Information, Course Material, Communication and Projects, each containing several subcategories. Two of the categories (Information and Course Material) supports interaction initiated by the teacher, (learner-instructor /one-to-many). Communication collects different ways for a student to interact (learner-instructor, learner-learner/ one-to-one, many-to-many). Finally, the Project category gives groups of students possibility to a more private interaction. Neither Moore's nor Paulsen's definitions of interaction could be strictly applied to the categories and sub-categories of DisCo, this is to a large extent due to the openness of the system. Most categories can be used according to the preferences of the course provider. Below is a short description and the intended use of each category presented. (See [Table 1] for description of all subcategories)

Information: The reason for splitting the teacher-initiated interaction in two categories was the idea that the information category should contain static files that could be present on the site when the course started, with low probability of being changed during the course. (The Course Material category was intended to be more dynamic in nature.) For instance a description of the course, its content, goals and methods for examination can be found here along with a presentation of involved teachers and help for students on how to configure their browser

Course Material: Most subcategories consist of dynamically generated listings with different kinds of content. Each item in such a list is a hyper-linked file-name, supplemented with a text abstract describing the content of the file. At the moment there are separate listings for material oriented toward study guidance, description of assignments and collection of external web-resources. A slightly different kind of listing generates an on-line self-correcting quiz, to be used by students in order to test themselves [Carbone & Schendzielorz 1997]

Communication: In this category we collected several techniques for student initiated interaction. First of all the students add their name and email address to a course-mailing list. To make students responsible for providing their correct address lifts a heavy burden from the shoulders of central administration, especially since many students have two or more different email addresses.
The next possibility to interact is to send email to the teacher(s) of the course. Instructing students to use the

DisCo e-mail form instead of their regular mail software has the advantage that the subject line can be automatically generated, a fact that allows the teacher to effectively filter his incoming mails into a course-specific mailbox. For students to submit their assignments as digital documents instead of handing in paper copies can in many situations be preferred. But as described earlier, the administration of these documents can be very time-consuming. In DisCo such digital hand-ins are uploaded to the web-server instead of being attached to email, (or even worse – handed over on a floppy disk).. The dialogue for submitting a hand-in, forces the students to write a rich documentation on the identity of the assignment (name of exercise, group-ID, name of authors, software-version etc). Thanks to this, there is no need for creating complex rules on how to name the files (which are simply renamed on submission) . Finally we have incorporated a threaded Debate Board, primarily intended for communication amongst students. Here they can post messages, ask questions and react to entries made by others. The teacher administrates the board.

Projects: Since more and more activities in both regular and distance education are done in groups, there is a need to support the collaboration of such groups even though they might be geographically dispersed, or just having difficulties to find the time to meat – face to face. This category is in a way a DisCo in miniature, a primitive groupware-tool where group members can upload files and engage in debate in their own password-protected area.

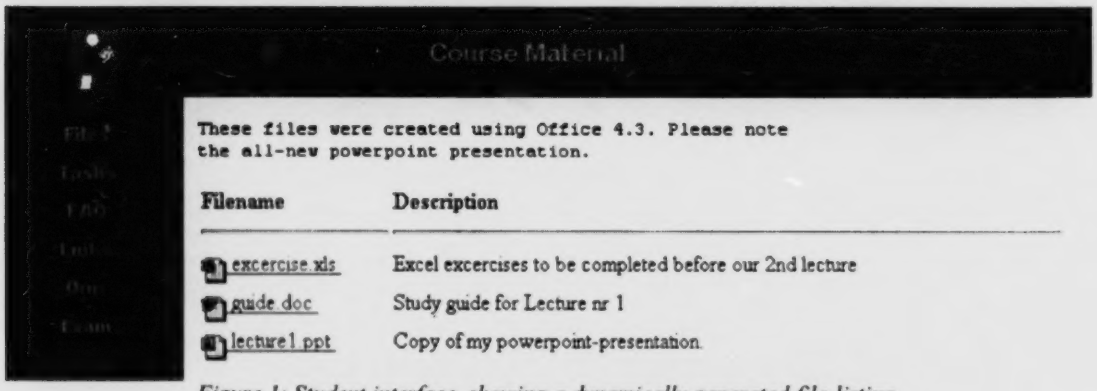

Figure 1: Student interface, showing a dynamically generated file-listing.

Navigating this two-level interface is done by buttons placed in frames at the top and to the left of the screen. Clicking on first level buttons updates the left frame, showing accurate sub-category buttons. Colours are used to indicate which buttons are pressed, thereby indicating the nature of the material in the content-area of the screen. Students can also choose to access the system through a non-frames, non-java script interface

Information		Course Material		Communication		Projects	
News	Bulletin board with latest information	**Files**	List with study-guides, lecture-notes, exercises etc.	**Sign Up!**	Adding your name to the mailing list	**Files**	Adding and deleting share documents
Content	Course description	**Tasks**	Detailed instructions for assignments	**Email**	Send an email to the teacher(s)	**Links**	Group collection of external URLs
Teacher	Presentation and addresses	**FAQ**	Frequently Asked Questions	**Hand-In**	Submit a file for an assignments	**Email**	Administer the group-mailinglist
Schedule	Dates and reedings for lectures assign-ments etc.	**Links**	Interesting course related web-sites	**Debate**	Threaded debate-board	**Debate**	Group-debateboard
Help	Users-Guide and Download sites for viewers	**Quiz**	Online self-correcting questionnaire	**Evaluate**	Form for evaluat-ing the system	**Admin**	Change password and allowed fileformats
		Exam	Results from exams				

Table 1: All Categories and sub-categories of the DisCo- System

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3 Maintaining a DisCo

When discussing the meaning of the term, Distance Education, the focus is often on students being separated from the school (in time and space). In DisCo, all course-site maintenance is being done via the Internet. A fact that adds another dimension to the concept of Distance Education; not even the teacher has to be present at school. This shift from student to teacher focus can be said to be the trademark or bearing concept of DisCo. Without teachers committing themselves to web education, little will be accomplished. The philosophy was to make a simple, yet powerful interface for the maintenance of the course site, minimising the need for computer skill and time.
The administrative part of DisCo is located to a password-protected area of the web-server, with a start-page containing links to maintenance-pages for all ongoing courses and some shared resources for all course-providers. I.e. a debate board where for instance suggestions of new features, reports on bugs and added functionality can be posted and discussed. This page also holds the possibility to create a new course. In doing so a small configuration file, containing names and email addresses for all teachers as well as format specifications for file-listings, is created. The teacher can alter these settings at any time. Furthermore the creation of a new course triggers a small perl-script that among other things is responsible for creating a predefined directory-structure on the web-server, to which all files used in the student interface are copied. This enforced standard allows the advanced author to use internal links from one html document to another.
In order to make maintenance easy, even for novice course-providers, we felt it was important to reduce the set of maintenance-actions to a minimum. There are basically two different techniques or actions that a teacher needs to master in order to provide a well-structured course to his students.

3.1 Edit text files

A number of the categories in DisCo contain static text/html documents. The technique to create or update this file is the same for all these documents. After choosing what file to update, the present content of the file is uploaded to a text-box where it can be edited by the teacher, and then re-submitted to the server. Since the text-box does not offer WYSIWYG-facilities, the result on how the file looks like viewed through a browser, is presented. If not satisfied, the teacher can repeat the process. If a richer layout and design is wished for, the more experienced author can choose either to hardcode html-tags into the text-boxes, or create complete html files in an editor of his/her own choice. If an external editor is used, the file is submitted to the server, given a file name matching the content of the file. (Of course images or other referred documents must be submitted separately.) Example of files that can be edited this way are the headers for the dynamically generated file-listings of the Course Material category, the static files of the Information category but also more dynamic documents like the FAQ, (Frequently Asked Questions), and the news-bulletin that serves as the default starting page for a course.

3.2 Show-Add-Delete

The other basic technique is used to maintain the content of the generated file-listings of the Course material category. For each of these, the interface has three buttons to serve this purpose. One to show the present content of the listing, one used to add a file (plus-sign), and one to remove a file from the list (minus-sign). In the add-file dialogue the teacher marks the file to be uploaded and writes a short text description of the content. If the format of the submitted file matches the specifications in the course configuration file, mentioned earlier, it will be included in the listing. Picture-files (GIF, JPG) are normally not formats that are specified to be listed, but can still be uploaded and referred to from within html documents on the listing.

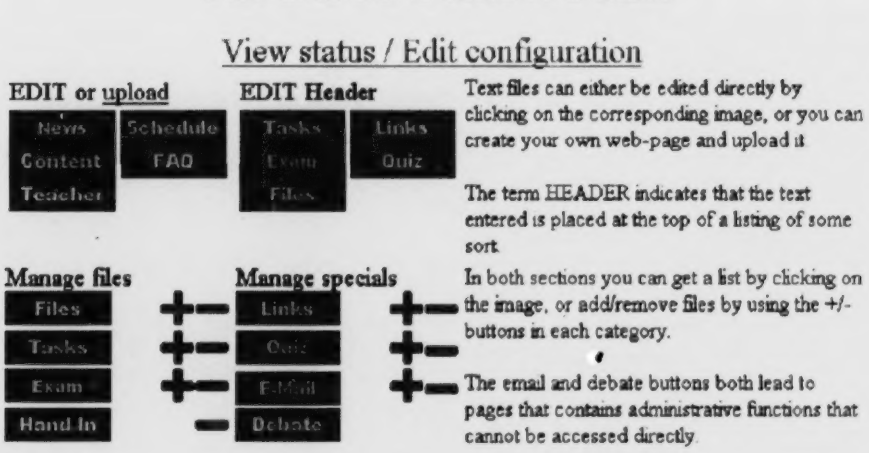
The DisCo Control Panel
View status / Edit configuration
EDIT or upload
News
Content
Teacher
Schedule
FAQ
EDIT Header
Tasks
Exam
Files
Links
Quiz
Text files can either be edited directly by clicking on the corresponding image, or you can create your own web-page and upload it
The term HEADER indicates that the text entered is placed at the top of a listing of some sort
Manage files
Files
Tasks
Exam
Hand In
Manage specials
Links
Quiz
E-Mail
Debate
In both sections you can get a list by clicking on the image, or add/remove files by using the +/- buttons in each category.
The email and debate buttons both lead to pages that contains administrative functions that cannot be accessed directly

Figure 2: The Interface for course-maintenance

3.3 Push

An often discussed property of the WWW is that it is Pull-technology [Wired, March 1997]. I.e that a user is forced to actively find the information and retrieve it through activating a hyper-link. In contrast, the term Push-technology is used to describe situations where information [Wired March 1997] seeks its receiver without being called for. The easiest way to facilitate a Push technology that makes the student aware of new entries to the course-site is to use e-mail [Stegberg & Svensson 1997]. The dialogues of adding a file or updating a text document both contains the possibility to check an option that will generate emails to all persons that has registered their address on the mailing list of the course. The message consists of information on where the new file is available (with complete URL) and the short description-text on the content.

4 DisCo Tech

The overall philosophy for technical solutions in the DisCo-system has been Easy and Cheap. DisCo is currently hosted on a P133Mhz with 32mb memory running RedHat Linux 4.2 and NCSA HTTPd 1.5.2a. DisCo consists of a number of small cgi-programs written in Perl (and occasionally, C). There are also a number of static HTML-files, for example the navigation frames, help pages, etc. A new course is created by filling out a form with brief course information. The cgi-program connected to the form uses an empty template course that is copied to a new course. A regular expression search and replace enters the correct values in the static html files and ads the proper links so that the course becomes accessible. The removal of a course is done in the same manner. A search and replace removes the links and the created directories are deleted. The majority of the pages the student sees are generated on the fly. By using the referrer-variable, as well as command line arguments, the same script can be used by all courses, which makes the system easy to maintain and update. The teacher uses the same scripts to view information, but also has access to the add/remove scripts. Adding files is done with html-forms using the multipart/form-data encoding type, which eliminates the need of additional ftp-software. The removal of files (or other resources such as links, student email-addresses, questions in the quiz) is done by simple point-and-click forms.

5 Closing remarks

We feel that most systems for web education are oriented towards a user-perspective. There are many impressive

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examples facilitating multimedia content, query-databases and on-line applications. For example see [Ahanger & Little 1997], [Carbone & Schendzielorz 1997] or [Bodner et. al 1997]. We have shifted the focus and concentrated on the basic needs of the novice-author, still allowing more experienced web-authors to do their tricks. The student interface of DisCo is designed for usability and to give a satisfactory level of structure to all course related activities

The system requirements previously listed [see Introduction], are all items in favour of easy authoring and maintenance but there are of course also prices to be paid from these simplifications. For instance, when encouraging teachers to publish files created in non-html formats, the possibility of providing full-text-search is limited. It also restrains the author from being able to create internal links from a hot spot within one document to a target within another [Nielsen 1995].

Even though our main concern when designing DisCo has been the course providers, we do not feel that users (students) are suffering from this. Evaluations so far show that students appreciate the system, although it should be noted that all students have had a two-week course in basic-computer-use prior to attending their first course. Using the system in a true 'novice-setting' (or with non-university students) could give a different result

We have several ideas on how to further develop the DisCo system. One of the more interesting is to develop the course creation function towards customisation, hence the teacher should be able to choose what categories should be used in the course. We also want to facilitate customisation at the user-end of the system. Many students take two or more courses at the same time and could therefor benefit from designing his/hers own DisCo-interface.

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URL to the DisCo-system: http://www.udd.htu.se/dl/test/frames.html

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Introducing advanced Information Technology in educational systems: Will this force a new pedagogical paradigm to emerge?

Abstract

Educational systems for distance education are designed with properties and functions that increase their dependence on the performance of telecommunication and information technology. A possible effect of this on educational systems is a shift of focus from teaching activities to the learning process. Extensive use of advanced Information Technology in educational systems makes the students less dependent on the teacher. The traditional role of the teacher as a source or reservoir of factual knowledge is challenged and may soon be replaced by the role of a provider in the learning process. The present paper investigates to what extend traditional theories of learning are becoming obsolete and if a pedagogical paradigm shift is required. By asking this question attention is inevitably directed to how the term, pedagogy is defined. Is it possible to define pedagogy, or the theory of learning, without refering to a technological environment and thereby the learners interaction with artificial tools?

These issues are elaborated and answers to the questions pursued with reference to traditional pedagogical theory and empirical results from experiments with distance education courses. The educational experiments are part of the research project, PedTek (Pedagogy and Technology), conducted at Hedmark College and Oslo College in Norway. The distance education experiments have been organized in accordance with Problem Oriented Learning and Collaborative Learning and involved approximately 100 students, geographically distributed throughout the County of Hedmark in Norway. The educational system made use of multi-participants video conferencing systems and the www as a basis for tutorial services and asynchronous communication.

Distributed Education using the mStar Environment [1]

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Abstract: The mStar environment for distributed education utilizes the WWW and IP-multicast to enable teacher-student collaboration over large geographic distances. Several educational projects, spanning from secondary school courses to company internal training, have deployed the mStar environment. This paper reports on experiences gained over a year of practice at the Luleå University of Technology and the Centre for Distance-spanning Technology. The paper presents the methodology and technology used, while recognizing usage scenarios such as preparation of presentation material, distributed presentations, asynchronous playback of recorded and edited material, and virtual meetings for educational support.

1. Introduction

The WWW community's strive for content quality has created a quiet revolution in education. In fact, much work in this field has been presented at past WWW conferences. The many efforts related to the educational uses of the WWW [Perron 94,Goldberg 95, Ibrahim 95] and virtual classroom environments [Lai 95] have been a major influence for this revolution. The availability of course related information such as lecture notes, extra course material, exercises, and course scheduling blended with the WWW's inherent qualities such as hyperlinks and accessibility have added much information to the classical structure of courses.

Although undeniably useful and valuable, education on the WWW has lacked a fundamental feature: the presence of quality video and audio for natural spontaneous interaction. WWW-based solutions such as 'HTML courses' for 'electronic-education' have somewhat restricted the exchange of information between students and their teachers. More recent technical solutions, such as the use of multimedia in WWW documents, are limited to simple playback control, thus leaving no room for spontaneous interactivity. This deficiency has prevented broader use of distance education on the WWW, since university courses should offer the opportunity for discussions and debate.

This paper reports on more than a year of research and actual usage of the mStar environment [Parnes 97a, Parnes 97b] in projects aiming to use and demonstrate the full potential of distributed multimedia education. It will first present a brief background, then put forward different usage scenarios and tools, and finally provide a detailed discussion about experience acquired from usage of this new education environment.

1.1 Background

Bringing quality distance education and collaboration to the Internet is one of the driving forces behind the Centre for Distance Spanning Technology, CDT, at the Luleå University of Technology. Many high schools cannot gather the critical mass and competence to offer the courses and subjects that are possible in the more densely populated areas. By giving WWW-based courses over the networks, a sufficient critical mass is generated, creating a county-wide virtual university with breadth and quality that might otherwise not be possible.

Furthermore, the funds per student are continously decreasing, where the resources left available will have to be used more efficiently. The normal way to compensate for funding cuts is to create larger student groups. An efficient solution to manage these bigger groups of students is having a more teacher-independent 'virtual student community', where students can collaborate in solving problems. This may reduce a teacher's increased workload due to bigger classes.

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[1] The paper is also available in HTML as a full-length research report:
<URL:http://www.cdt.luth.se/publications/19971201/report.html>

Giving WWW-based courses and creating a virtual student community is made possible thanks to a unique Internet engineering project, IT Norrbotten, which has built a multicast enabled high-speed network infrastructure between communities and companies in the county of Norrbotten. Together with the University campus network, this has created an excellent communication framework for distributed education.

The Luleå University of Technology has given a number of courses using the mStar environment, ranging from graduate-courses to full fledged under-graduate courses. The first course using the technology was about the technology itself, Distributed Networked Multimedia. About 110 under-graduate students followed the course together with an additional 30 students from the county area. Other under-graduate courses have been given using the same methods, such as a course in Object-Oriented Programming with more than 120 students. All of the graduate courses at CDT have been conducted using the mStar environment as well. Therefore, the University has achieved a significant deployment and usage of distributed education over the Internet.

Today many large companies, such as Telia and Ericsson, are showing a growing interest in the technology as well. Several courses for the companies have been given using the technology, and the Ericsson deployment is progressing rapidly. Giving joint courses might help bridge the gap between local industry and the university. mStar is used for courses and presentations as well as traditional meetings, thus reducing the need for travelling.

This paper therefore presents the concrete results of a wide deployment effort of the mStar environment for distributed education where secondary schools, the university, local companies and communities are all active participants. By now a large amount of persons have tried the mStar tool suite for education, with varying degree of satisfaction. We are now only starting to see the first social and cultural changes within the schools and companies involved.

2. mStar Distributed Education Scenarios

The mStar environment is used in a number of education related scenarios, which today is used to give real-time interactive courses.

2.1 Preparation of Presentation Material

The first scenario is one of preparation of a lecture's content, which involves preparation of traditional presentation material using HTML. The benefits of HTML for an overhead medium are numerous:

- Traditional WWW hyperlinks that point to more information can be inserted in the slides.
- Users viewing these slides on their desktop computer can control the document's window size, font sizes and colors. This can greatly help people with viewing disabilities.
- HTML is a very portable format that is widely supported across numerous.
- Multicasted HTML slides uses very little network bandwidth in comparison with video captured slides.

With the help of SlideBurster, the teacher can divide a single HTML document into a number of different slides. The tool automatically creates links to each of the slides and creates an outline for the lecture. Once the slides are ready, the teacher can publish the slides on the course's WWW pages before each lecture. Overall, this step helps the students to prepare for lectures as well as enhances the quality of the class material thanks to the many hyperlinks to related material.

2.2 Distributed Presentations

Once the course material prepared, the teacher or a class technician must go through a number of steps:

1. For students to 'tune-in' to the lecture, the MBone session must first be created and announced on the WWW. This is done via the WWW-based session directory mSD (multicast Session Directory), and mAnnouncer (multicast Announcer) [Parnes 97a p.4].
2. Once the different media sources are being transmitted, a tool called mVCR (multicast VCR) is used to start recording on the mMoD (multicast Multimedia on Demand) server [Parnes 97a p.7].
3. During the lecture, the technician can remotely control positions, zoom and focusing of the two cameras inside the lecture hall with the help of mDirector (multicast Director) [Parnes 97a p.9]. The cameras are used together with video grabbers to digitally capture the audience and the teacher.

The audio and video streams are sent throughout the network using IP-multicast [Deering 91]. The students can 'tune-in' to the appropriate lecture by pointing their browsers to mSD's WWW page. mSD's main purpose is to present an interface to available sessions. From mSD students can launch the proper tools, such as VIC (Video

Conferencing Tool)[Jacobson 95] for video, mAudio (multicast Audio) [Parnes 97a p.5] for audio as well as the other mStar tools. This simple step is critical since only limited technical knowledge should be required to fully take part in a session. Hence, a lecture is never more than 'a few clicks away'. The participant is then 'submersed' in an environment that takes distance education a step further from traditional HTML-based courses.
The student is no longer a passive receiver as he can interact in real-time. Students participating physically in the lecture hall can hear questions asked by online participants through the audio system and see the online participants through a projection on a wide screen. Naturally, they are also heard by all other on-line participants. This creates a very symmetric environment for two reasons:

1. All participants has access to the same facilities and can participate equally in discussions. We feel that this is a very important feature for promoting student participation and debates between class members.
2. The delivery of all the multimedia content is achieved through IP-multicast, which substitutes the traditional client-server structure for a symmetric method of delivering multimedia content.

As the lecture progresses, mWeb [Parnes 97a p.39, Parnes 97c] is used to synchronize the teachers' WWW browser with the participants browser windows, thus working as a distributor of presentation material. This greatly improves the overall ease of use as well as the lecture's natural flow for the on-line participants. The mWeb is an important part of the environment; therefore it is extensively described in section 3.

Meanwhile, a participant can interact with the teacher and the other participants by raising his hand using mWave (multicast Wave) [Parnes 97a p.17 (was mW2T)], thus imitating the social protocols of a normal classroom. Participants can also use mChat (multicast Chat) [Parnes 97a p.6] and mWhiteBoard (multicast WhiteBoard) [Parnes 97a p.6 (was mWB)] to discuss issues with other on-line students without interrupting the lecture or to part in lecture exercises. Interaction can also take the form of voting on different issues by using mVote (multicast Vote) [Parnes 97a p6]. This gives on-line students possibilities that do not exist in a classic classroom environment.

Furthermore, the teacher can include a playback of a recorded session into the live lecture, which enable reviewing and debating of related recorded material.

2.3 Asynchronous playback

The lectures are recorded using the mVCR application, and then edited using mEdit [Norrgård 98]. Indexes, i.e. named temporal points in the lecture, can be added by the technician while the lecture is taking place or by the teacher afterwards. A teacher can also add comments, modify the flow of events, remove sequences such as a long pauses and insert previously recorded multimedia content. Adding slides, a famous speech by a Nobel prize winner or a clip from a previous lecture can easily add a lot of content value to a lecture.

The WWW interface to the mMoD server allows reviewing recorded lectures by starting playback sessions. Participants can join in on playbacks currently being played by others or start their own playback. Interaction between the participant and the mMoD server is done via a mVCR control-applet started from the mMoD WWW page. mVCR provides basic VCR-like functions and access to the indexes of the lecture. It enables the student to quickly jump to the desired part of the lecture without having to fast-forward through the lecture. During playback, the participants can view all multimedia sources and events that occurred in the original lecture. The flow of the slides, mChat, mWhiteBoard and mVote events are all preserved and played back.

2.4 Virtual meetings

Aside from lectures, using this environment in combination with newsgroups and traditional mailing list can create a 'virtual student community' in which students can help each other for labs and participate in course related discussions. Students are able to cooperate and interact with each other using the previously mentioned suite of tools. Helping other students with labs, course questions or simply sharing experiences add a collaboration dimension to distance based courses. Creating such a community, as described in [Lai 95], can be very useful for both students and a teacher's workload.

It is also possible to have a 'virtual teachers room' session using audio and video tools. This works like a virtual corridor, where the students enter and ask questions or discuss course-related issues. For distant students it is naturally very important to have a continuous contact with the teachers.

By combining the possibilities offered by available networks, the collection of portable tools written in Java, the accessibility and ease of use of the WWW and the benefits of IP-multicast, we have been able to make these scenarios part of our everyday, real-life teaching experiences. We would like to stress that this is a working system in real use.

3. The mWeb Application

The mWeb application is a tool for real-time distributed presentations in HTML. The application includes functionality for distribution of HTML-pages, including in-line data and embedded objects, pre-caching of files to be used within a session, on-demand fetching of files and synchronization between browsers. mWeb uses the mDesk framework for distribution and control [Parnes 97a p.23, Parnes 97d].

The mWeb application acts as a gateway between a WWW browser and the MBone, mediating distribution of HTML-pages and 'display-messages'. The application can also run in a lightweight mode, where only the URLs to be displayed are multicasted. This is useful in smaller groups as the delay becomes shorter and the network usage does not significantly change.

Normally URLs are collected dynamically during a presentation using the special mWeb WWW-proxy that sends information about the requested pages to the mWeb application. This is achieved by directing the browser to request all pages through the proxy, instead of fetching them directly. Offcourse a list of URLs can be prepared before a presentation as well.

The first problem related to distribution of the WWW based presentation material is how to distribute WWW pages efficiently to a large group of listeners. The solution is that the presenters mWeb instance fetches the page content to be presented from the server and then distributes it to the listeners. The distribution is done using the /TMP (Tunable Multicast Platform) [Parnes 97a p.26], which allows for reliable transfers using the inherently unreliable IP-multicast.

When a presentation is distributed over the MBone and a WWW browser is used for presenting the slides, there is a need for synchronization between the involved WWW browsers (that all involved browsers display the same page). This is solved by sending a display-message to all members of the group using the CB (mDesk Control Bus) [Parnes 97a p.26].

During the session, all pages that are received are collected in a list. The listener has the choice of either automatically displaying a new page or manually clicking on the list entry to display a new page. If a listener wants to go back and view an already displayed page, s/he can select the page of interest in the list of received pages and that page will be displayed locally. The user can also instruct the local mWeb client to send a display-message to all other listeners including the presenter. This is useful if the listener wants to comment or ask a question related to a page that is not currently displayed.

4. Discussion

We have noticed that using mStar to teach about it's own underlying technology was a very good idea. By doing this, students that take the course are often more technology oriented, and are less hesitant towards using a microphone and video camera to interact. The under-graduate courses at the university are becoming very popular, perhaps because they teach technology using technology.

The statistics from our mMOD server logs show that many students prefer to watch lectures during evenings, or even late at night. Offering the opportunity to study asynchronously has its price; the lectures are becoming less frequently attended. This might not be entirely negative, as courses today are growing in size with sometimes more than 120 students, and it can be very useful for students having overloaded daytime schedules.

Using the playback facilities offers another clear advantage: it enables students to take pauses, to either read additionally related information or to consult the course literature. Unfortunately, these students can not be part of the spontaneous discussions during lectures. Having multiple participants active in the playback environment might remedy this to an extent, but this is clearly an area to be improved.

The multiple gathering of students in groups to listen to the playback of a lecture is also a remedy to the latter problem. This social behavior might come from a need of discussing the material similar to discussions that take place in an ordinary lecture.

We have noticed that other social protocols have been established when using the environment for presentations and education. Foremost are the sub-discussions that take place using the mChat and mWhiteBoard tools, where a set of the participants either discuss the presenters material or something completely uncorrelated. This kind of discussions and sharing of information enhances the learning experience, since attending a lecture physically normally disallows side conversation in the audience.

By encouraging the use of different means of communicating electronically, such as email or WWW-based

discussion media, we have found that students tend to help each other. This form of social clustering, is most interesting. Not all choose to take part, but since a large number does, it lessens the traditional burden of a teacher. Students with additional knowledge have also the opportunity to share it with the rest of the class and the teacher. The fact that students are able to share this knowledge with the group is an enormous advantage to more traditional teaching, where students seems to rarely form groups with more than five members.

An additional observation made using the mStar environment for lectures is that lectures tend to become more static than classical (i.e. non electronic) lectures. Experienced teachers are most often those who can improvise and dynamically alter the course of a lecture. These teachers usually do not need to prepare overhead material, as their lectures often take the shape of a normal conversation. With mStar, teachers are easily 'caught' in the flow of their pre-made electronic material. It is therefore very important to still allow the teacher to improvise, perhaps by adding links to in-depth material from the original presentations and making use of an electronic whiteboard or a sketchboard.

Furthermore, a technician is needed to achieve the best transmission quality for the lectures. The technician controls audio levels, camera focus and positions, recording management and lighting in the lecture hall. This means that two persons are needed to conduct a distributed lecture. This extra requirement in human resources should be justified by the fact that no teachers are needed at the 'distance-based' locations. The use of movement-tracking cameras and automatic audio level control equipment, can remove the need for the technician.

Traditional distance education methods usually take the shape of TV broadcasts. In comparison with the mStar environment, networked distance education offers more than the ordinary TV broadcasts. Although mStar could certainly be used in a more 'TV-like' environment, such as a one-to-many broadcast media, there are some fundamental differences:

- Setting up TV sessions can create many distribution-related headaches. Broadcasting regulations and equipment availability are two major potential pitfalls. With the multicast technology used in mStar, sessions are more lightweight and are easier to create. Multicast sessions also allow for more channels than the two available educational TV broadcast channels in Sweden.
- TV offers no interactivity at all, while net-based education can offer several means for interactivity.

Finally, training teachers at remote secondary schools has had a very positive effect. These teachers tend to spread the gained knowledge about this technology and information technology in general, creating a very nice momentum for mStar and for the teachers in general. The fear that knowledge about information technology is decaying at secondary schools in Sweden can therefore clearly be met. For sparsely populated areas like the county of Norrbotten, networked distributed education might be the future. If the Internet is the next industrial revolution, then netbased learning may be the next educational revolution.

5. Summary and Conclusions

This paper describes a novel multimedia environment for distributed education offering many different usage scenarios. The mStar environment consists of a tool suite for preparation of presentations, distributed presentations, playback of recorded and edited multimedia content, and synchronous virtual meetings. These tools and scenarios, tightly integrate the WWW in a close relationship with IP-multicast technologies.

The variety of usage experiences and the successful county-wide deployment clearly demonstrates that mStar is indeed scalable in more ways than one. From small informal presentations to complete university courses, we have shown the strength of this novel education environment.

We have argued this from a variety of perspectives, all showing that this environment offers extended support for interactivity, better help through the use of a 'virtual student community', as well as on-line availability of all course media. The goal is to create an educational environment that can be qualified as better-than-being-there, bringing everyday situations such as interacting, learning and collaboration to the Internet.

6. Future work

The most important future enhancement of the mStar environment is in the field of usability, where a study could be done by having two user groups, one that follows a course remotely and one that follows it locally, and then compare the results. In addition, better mMoD logs might reveal interesting statistics about usage. These results should help in making mStar easier to use. Using mStar should not be harder than just clicking on a link, especially for primary and secondary school students.

The users of the mStar environment have identified a need for further development, in order to better support distributed education. The most frequently requested functions are:

- An enhanced SlideBurster with support for outline editing, HTML templates using Cascading StyleSheets and incorporation of the new W3C standard SMIL.
- An integrated tool for playback of audio, video and HTML (replacing VIC, mAudio and mWeb). This component should be implemented with the Java Media Framework to achieve portability.
- Support for a movement-tracking camera together with automatic adjustment of audio volume levels, which will lessen the need for a technician.
- Privacy through encryption of the media, for sensitive or confidential information. This is also needed for 'pay per lecture' education.
- One-to-one audio/video communication within a larger session, for side conversations.
- General application sharing across platforms.
- Remote pointers for pointing certain paragraphs or positions in HTML slides.

Another area of future work is enhancement and expansion of the virtual student community, since spontaneous discussions among students and teachers are vital, even if asynchronous. Adding a shared information space like a WWW based bulletin-board will be investigated, perhaps by using the education framework presented by Lai et al [Lai 95].

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Reducing Web Browsing Delay using Profile-Based Prefetching

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Abstract: This paper presents a novel technique for prefetching Web pages using the access patterns captured from the past behavior of the clients. For each page requested, the client also prefetches the relevant pages and downloads them along with the requested page in a batch to save communication overhead. The prefetching of these relevant pages can be done while the user is browsing through the requested page. Since future references to these prefetched pages can be satisfied without further communication to the server, this approach noticeably reduces the amount of time needed to browse the pages. The simulation results presented in this paper confirmed our observation.

1 Introduction

World-Wide Web (WWW) is the most popular application of the Internet today. The Hypertext Transfer Protocol (HTTP) is a simple application-level protocol used by WWW to provide convenient access to vast amount of geographically distributed information written in Hypertext Markup Language (HTML). Each HTTP interaction of HTTP 1.0 [Berners-Lee 93] comprises important steps as follows. The client opens a TCP connection with the server. After the client receives an acknowledgment from the server, it transmits an HTTP request to the server which performs some tasks to satisfy the request (i.e., retrieve an HTML document or execute a CGI program), sends the response back to the client, and closes the TCP connection. Upon receiving the response, the client parses the returned HTML document, so called page to extract inlined images (i.e., images embedded in the document). Each inlined image requires one HTTP interaction.

The explosive growth of WWW itself places an extreme demand on the network infrastructure. Moreover, HTTP's simplicity contributes to excessive network bandwidth requirements due to the following:

- **High connection costs**: One round trip time (*RTT*) is required to setup a connection between a server and a client. At least half of the time is due to propagation delay [Padmanabhan et al. 95], which cannot be further improved. Connection establishment also incurs processing overhead on both server and client.
- **Non-persistent connection**: For each inlined image in the requested page, a new connection needs be established instead of using the connection previously established for the requested page. As a result, two round trip times are required per page or one inlined image: one round trip time to setup a connection and another to fulfill the request.
- **Slow start**: To avoid network congestion, when a TCP connection is first started, the sender must wait for an acknowledgment packet before it can transmit more packets. Light network traffic would then allow the sender to transmit more packets before it waits for acknowledgments of those packets previously sent.
- **Non-shared congestion information**: Non-persistent connection causes unnecessary connections for a requested page with at least one inlined image; network congestion information realized in the first connection is not shared by the following connections. For the congested network path, these connections will interfere with each other.

To address high demand on the network bandwidth and improve the amount of time needed to retrieve pages, several approaches have been taken and can be categorized as follows:

- **Persistent Connection**: Persistent connection significantly reduces TCP open/close connection overhead by sharing a connection among multiple HTTP requests. That is, requests for inlined images in the page are

serialized within the connection. Persistent connection is included in the current HTTP protocol (HTTP 1.1) [Fielding et al. 1997].

- **Pipelining**: This approach aims at reducing the number of packets transmitted, it can be further divided into two techniques:
  - *Server Initiative*: Upon receiving an HTTP request from a client, the server retrieves the requested page and parses it to extract inlined image references (e.g., <IMG SRC="welcome.gif">). It transmits the requested page, retrieves the inlined images, and transmits them in the order of the references [Padmanabhan et al. 95]. This technique saves about half a RTT for each image in addition to the savings due to persistent connections.
  - *Client Initiative*: Upon receiving an HTTP response from the server, the client searches the received page for inlined image references. For each inlined image reference, it issues an HTTP request to the server without waiting for a previously requested image to arrive. The response messages are still serialized [Nielsen et al. 96].
- **Caching**: Caching is the most popular approach because it effectively reduces network bandwidth requirements. This approach does not require changes in HTTP protocol. Caching can be done per client basis and/or through cache servers named *Proxy servers*. In essence, frequently requested pages are maintained in memory and in disk cache. When requested, these pages are returned to the client without contacting the source servers. WWW caching techniques have been investigated quite extensively in both academia (e.g., Harvest Cache [Bowman et al. 94, Neals et al 96] [Williams et al 96]) and industries (e.g., Netscape Proxy Server [Netscape 98], Oracle WebServer [Oracle 98]).
- **Push Technology**: Among the aforementioned approaches, Push technology is the newest effort to improve the time one takes to browse Web pages. In essence, Push technology allows users to specify their interest at different levels (i.e., page level, site level, etc). Push servers and clients collaborate to deliver these pages to the users periodically or according to user-defined schedules. As a result, the users can browse through the pages with essentially no waiting time provided that they are not interested in any other pages.

In this paper, we present an alternative approach, *Profile-based Prefetching* (*PbP*), to improve the Web browsing time. The technique can be used in addition to the techniques mentioned above. In our technique, when HTML documents referred in hypertext links in a page are predicted as strongly related to the requested page according to the server profile, these documents will also be fetched and transmitted to the client along with the requested page. Once the requested page arrives, the browser can present it to the user while it is downloading the prefetched pages. When these pages are later requested, since they are already in the client prefetch buffer, no further communication to the server is needed. It is not obvious to determine at what level of relevancy should a page be prefetched. Prefetching too many pages may affect the overall performance of the network if they are not used.

The remainder of this paper is organized as follows. In Section 2, we describe the proposed prefetch technique in detail. The simulation model and the performance results are discussed in Section 3. Finally we give our concluding remarks in Section 4.

2 Profile-based Prefetching (PbP) Technique

2.1 Motivation

Profile-based Prefetching technique is motivated by the fact that in general, once a user goes to a Web site, he/she generally browses around for several pages before leaving for another site. Since the user follows hyperlinks upon his/her interests, it is likely that links are not followed uniformly. If all pages in which the user is interested can be downloaded in a batch, we can address the problems of (i) high connection cost, (ii) non-persistent connections, and (iii) slow start because browsing through these pages will not incur anymore communications to the server.

We can either predict each user's interest using cookies or mine a consensus of interests (i.e., generally what pages will be requested after the current page) with some confidence from the access log files recorded by the

Web Server. This information not only is valuable for the Web administrator to eliminate uninterested pages, or balance loads among servers, but also can help to improve Web browsing time. To verify this approach, we developed a prefetching algorithm presented in the following subsections.

2.2 Terminology

Let us clarify in the following some of the terminology used in this paper.

Client	Browser issuing HTTP requests to some server
Source server	Server publishing HTML documents requested by the clients
Page	HTML document containing anchors and hyperlinks to other pages
Parent page	Page being requested
Descendant page	Page directly and indirectly referred to by its parent page
Child page	Page directly referred to by its parent page
Co-reference (CR)	Probability (percentage) that a child page is needed after its parent page is browsed
Co-reference profile	Data structure containing co-references of related pages at a site
Co-reference threshold (CT)	Minimum co-reference for the client to accept the prefetch of the descendant pages

Figure 1 shows an example of pages residing at a fiction site, *www.science.ucf.edu*. *facility.html*, *departments.html*, and *map.html* are child pages of *welcome.html*. *cs.html*, *biology.html*, and *history.html* are child pages of *departments.html*. The numbers between pages are the co-references. For instance, the co-reference of *departments.html* is 90. We will use this example to illustrate our technique.

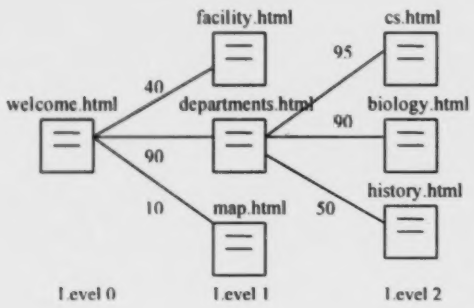

Figure 1: A Web site structure.

2.3 Technique

Initial Step: The server constructs its co-reference profile by applying data mining techniques [Agrawal 94, Agrawal 93] on its access log file. This issue is beyond the scope of this paper. We note that a co-reference is a measure between a child page and its parent. A co-reference of 100 means that every retrieval of the parent page is followed by a retrieval of the child page. A co-reference of 0 indicates that the child page is very unlikely needed after its parent page has been retrieved. The following demonstrates an interaction between the client and its source server when PbP is deployed:

Step 1: If a request is not a GET request, the client submits the request according to an HTTP protocol, and goto **Step 5**; otherwise, the client checks its local *prefetch buffer* for the requested page.
  a) If the page is already in the buffer, goto **Step 5**
  b) Otherwise, the client opens a TCP connection with the source server.

Step 2: After the connection is established, the client sends its HTTP GET request for the page. It also transmits the desired co-reference threshold along with other HTTP request headers. PbP allows clients to specify

their own co-reference thresholds since the clients may have different perspectives of how one page is "strongly related" to another.

Step 3: Upon receiving the request and its headers, the server retrieves the requested page and selects its descendant pages to transmit back according to the following criteria. A descendant page is prefetched if its parent page is prefetched, and its co-reference is greater than the co-reference threshold. The relevant pages can be visited in a breadth-first order starting from the page requested. The traversal can be limited to a fixed number of levels determined by the Web administrator. Since cyclic graphs, instead of trees, can occur in practice, the traversal along a certain path should be pruned if pages in the path have been visited previously. We note that the traversal is done using the profile that maintains only the hypertext linking information, not the page contents. This step, therefore, can be done very efficiently.

Step 4: The server transmits the requested page back followed by the descendant pages satisfying the prefetch criteria. It then closes the connection.

Step 5: The client interprets and displays the page. If this step is reached from **Step 4**, the client continuously receives the descendant pages while rendering the requested page. The prefetched pages are cached in a local buffer for future references.

We note that password protected pages should not be prefetched due to its protective nature. CGI programs should not be prefetched since their output can be large. Similarly, audio and video files are typically large, and should not be prefetched. Wrong prediction on these files would significantly waste network bandwidth.

To illustrate our strategy, let us consider the Web structure shown in Figure 1. Suppose that there is an HTTP GET request to *www.science.cs.ucf.edu/welcome.html*, and the desired co-reference threshold is 50. In this case, department.html is the only page in level one, which will be prefetched. This decision automatically excludes page *library.html* from being considered for prefetching. Among the three pages in level two, only *cs.html* and *biology.html* will be prefetched since their co-references are bigger than the co-reference threshold.

3 Performance Study

In this section, we develop a simulation model and present the performance comparison of the proposed technique and that of HTTP 1.1 protocol. Due to space limitation, we briefly discuss our simulation model and some of the results in this paper.

3.1 Simulation Model

We opt for a simulation model that is simple, yet can demonstrate the relative performance difference of the two techniques. Since both HTTP 1.1 protocol and PbP support persistent connection, in this simulation, we will not model the time cost of establishing and closing connections. We also assume that the time cost for issuing an HTTP GET request is negligible compared to the time cost for transmitting a page over the network. This is to be fair for the HTTP protocol since for each requested page, several GET requests need to be issued for its relevant pages while PbP issues only one GET request for the same relevant pages.

Average latency per page is used as our performance metric. It is an average time taken since a client submits a request until it receives the requested page. It is formally defined as

$$Average\ Latency\ Per\ Page = \sum_{all\ clients} \frac{Total\ wait\ time\ for\ a\ client}{Total\ number\ of\ completed\ requests\ for\ the\ client}$$

The reduction in the latency leads to the improvement in the users' browsing time. That is the users can browse through more Web documents given the same time period. We measure the latency in two situations: when clients behave according to the server profile and when they do not. We describe these two scenarios in more detail in the following:

- **According to the Profile**: Let us consider a child page with co-reference c with respect to its parent page. To determine whether the client will also request this child page after it has requested the parent page, we create a random number between 1 and 100. If the random number is greater than c, the corresponding child page is not needed; it is requested, otherwise.
- **Random Access**: In this situation, after downloading a parent page, to determine whether the client also wants to request a particular child page, we randomly create a number between 1 and 100. If the random number is less than 51, the child page is not needed; it is requested, otherwise. Thus, each child page has the same probability of 50% of being requested after its parent page has been downloaded.

Although the access pattern should generally follow the client behavior captured in the profile, the random-access workloads were included in our study to investigate the effect on clients who behave significantly different from the norm. In practice, this client should set a higher Co-reference Threshold to avoid downloading unneeded pages. To facilitate our simulation, we first conducted the following experiment.

a) We randomly requested pages from 120 different actual Web sites. For each page, we measured the time taken to retrieve the page, the page size in bytes, and the number of hyperlinks in the page, which refers to other pages from the same site.
b) We calculated the average of these measurement values. The average number of hyperlinks in a page was 15, and the average page size was 7650 bytes. The data transfer rate was 25000 bit per second (bps).

We use the above values in our simulation. The number of network channels was fixed at 60, which is calculated from the bandwidth of a T1 line (1.5Mbits/sec) divided by the data transfer rate. The network channels were shared among 1000 clients. They concurrently issued requests to the same server maintaining the co-reference profile. After the requested page arrived at the client, the client waited for some period of time (Think time) before issuing another request. Which page to be requested was determined, based on the scenario (according to the profile or random access) being considered. Think time is introduced to simulate the time the user takes to browse through the retrieved page.

3.2 Simulation Results

We varied the co-reference threshold from 20 to 100. Think time was varied from 60 seconds to 140 seconds. The results are plotted in Figure 2.

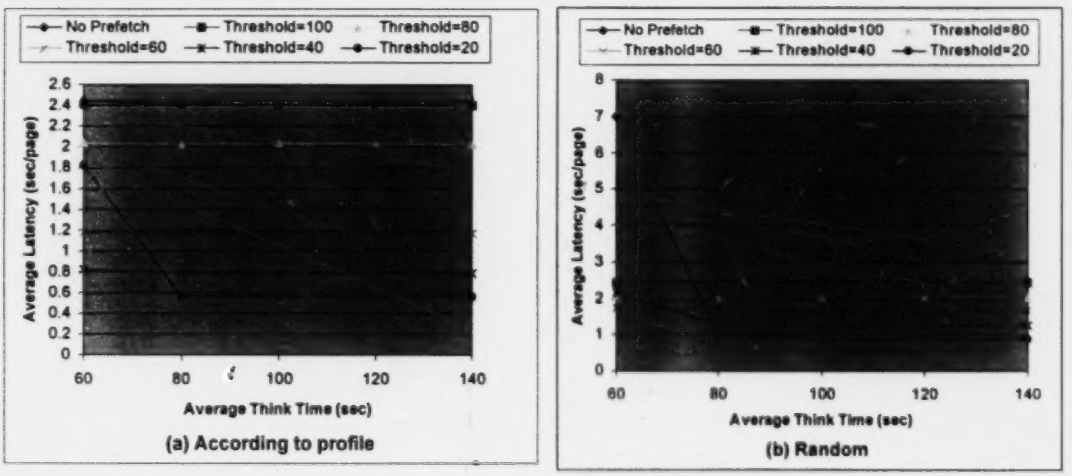

Figure 2: Average latency under various Think times

Figure 2(a) demonstrates the performance comparison of the two techniques when the clients follow the global profile. The two techniques perform comparably only when the clients set their co-reference thresholds to 100.

For most co-reference thresholds, PbP noticeably outperforms the HTTP protocol. This is because PbP takes advantage of the time while the user is thinking to download the relevant pages. We observe that the smaller co-reference threshold leads to the better latency in most cases in our study.

Comparing Figure 2(b) to Figure 2(a), we observe that the improvement in the latency is reduced. When the co-reference threshold is 20 and Think time is less than 80 seconds, PbP performs much worse than the HTTP protocol. This is because PbP prefetches too many pages, and these pages are not referenced. To provide a good average latency for various Think time, co-reference threshold of 20 and 40 are not good choices when the client behaves differently from the profile. Nevertheless, PbP with higher thresholds still outperforms the HTTP protocol.

4 Concluding Remarks

The advance in networking and server technology has revolutionized the way we publish information on the Internet. In recent year, WWW has evolved from retrievals of simple text/HTML pages to include also images, and at the present time, audio, video and Java applets. To accommodate these new features, several techniques have been investigated to extend HTTP protocol to better support the new functionality.

This paper presents another approach to improve HTTP performance using the access pattern captured from the past behavior of the clients. The co-reference probability of the Web pages are used in our scheme to determine whether to preload some of the pages along with the one requested to minimize the communication costs. Comparing this Profile-based Prefetching technique with HTTP, our simulation results indicate noticeable saving for service latency. We also observed from our studies that the proposed technique is able to maintain superior performance even if the clients do not behave in accordance with the server profile. To make our technique useful to a wide range of conditions, clients are allowed to specify a threshold to control the locally desired degree of preloading. Alternatively, the server can set the global threshold shared by all clients. In this case, a larger threshold can be used to limit the prefetching to only pages with very large co-reference probability, if large variances were detected in the server profile. Global thresholds were used in our simulation studies.

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HyperAT : Addressing Usability Issues In Web Authoring

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Abstract: Usable web pages that subscribe to end-users' needs should be developed. This is uncontentious wisdom, but doing this is not easy. This paper suggests a framework to understand usability issues, and discusses HyperAT, a prototype web authoring tool implemented to test these ideas. The approach taken in HyperAT is novel in that *multi-disciplinary* approaches drawn from current technologies in sub-disciplines of hypertext, human-computer interaction, cognitive psychology and software engineering are integrated and culminated into a practical authoring tool.

1. Introduction

Ad hoc methods of designing, constructing and validating web pages are not enough. If designers get "lost" when navigating websites, end-users do too. [Nielsen 1996] predicts that due to a change in the dominating styles for websites over recent years, a real contribution essential for web design should consist of further research into these different knowledge areas: (i) knowledge of icon design; (ii) knowledge elicitation to discover appropriate information space structures; (iii) usability testing; and (iv) task analysis techniques.

But searching for solutions in isolated disciplines, and recommending them to designers in the hope that they would somehow remember to put them into practice, may not be as simple as it sounds. Many factors could have prevented well-intentioned designers putting these good suggestions into practice. One of which could be that designers might be too overwhelmed, and/or seemingly might not have the time and capacity to attend to all these authoring details.

In order for Nielsen's suggestions to be truly effective and implementable, this paper argues that it should go beyond just providing designers with a list of do's and don'ts. Designers need authoring help. If some of these ideas could be automated so that designers need not worry about their implementation, chances are that better websites could be produced since designers would be freed to concentrate on other critical issues that cannot be automated, but require sound human judgement and expertise.

This paper describes HyperAT, a research tool to help designers manage the complexity of the design and validation processes without themselves getting "lost". The approach taken in HyperAT is novel in that *multi-disciplinary* approaches are integrated and culminated into a practical authoring tool.

2. Multi-disciplinary framework to understand usability issues

HyperAT stands for "Hypertext Authoring Tool". HyperAT is a prototype designer tool for authoring hypertext and web documents. The philosophy and the underlying concepts taken in the design of the authoring and usability components in HyperAT are described in greater detail in [Theng et al. 1997]. In this paper, we give a general overview of HyperAT, its inputs and outputs [see figure 1], and focus on the implementation and evaluation of HyperAT.

Inputs refer to the *multi-disciplinary* approaches that underlie the design of the authoring and usability components. Approach One examines design principles, and in HyperAT, it is examined in the form of good web style guides. Approach Two emphasises the importance of understanding end-users' needs and the tasks they perform. In HyperAT, we explored end-users' browsing needs on the web. Approach Three stresses good

structuring, and therefore in HyperAT, good web page structure to help both designers and end-users is investigated.

Outputs are the deliverables produced by HyperAT. Besides providing the basic authoring facilities to produce web pages, HyperAT also delivers usability results to designers regarding any usability problems that might be detected during its analysis.

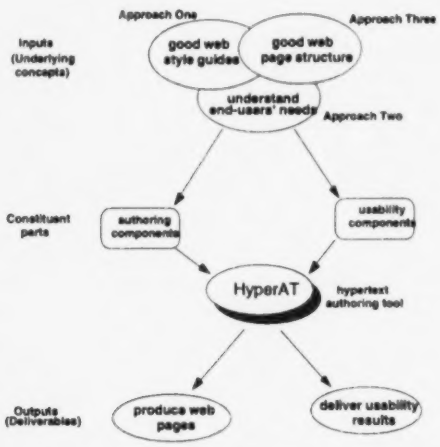

Figure 1: General overview of HyperAT, its inputs and outputs

3. HyperAT: Implementation And Initial Evaluation

HyperAT is implemented in Macintosh Common Lisp (version 3.9) for PowerPCs. It is not the intention of HyperAT to provide a full range of editing facilities with attractive interface, and HyperAT does not claim in any way capable of competing with commercial tools in this aspect. However, being a research tool, we see HyperAT contributing in these areas: (i) HyperAT is a practical authoring tool to help hypertext designers build usable hypertexts; (ii) HyperAT is an experiment in collaborative efforts involving many disciplines; and (iii) HyperAT is an analytical research tool for contextualising and delivering the results of hypertext usability to hypertext designers.

3.1 Authoring components

The main objective of HyperAT is to help designers build usable, well-structured hyperdocuments. In designing the authoring components, we incorporated two underlying design concepts, that is, the need to impose a structure, and the need to incorporate good web style principles and guidelines.

The authoring component in HyperAT provides the basic authoring environment for the creation and modification of hyperdocuments. HyperAT's facilities are accessed using a graphical, user-based interface. Hyperdocuments are created via a form-like screen and converted into predetermined HTML format, which can be displayed on the web using a web browser. During the conversion of the hyperdocuments into HTML codes, HyperAT also generates a table of contents, a hierarchical representation of the structure of the hyperdocuments, accessible from every page of the hyperdocument, using the "contents" button. A fisheye view of related pages with respect to users' current page is also provided to help users better understand the structure of the hyperdocument in relation to where they are, thus ameliorating the "lost in hyperspace" phenomenon [Theng 1997]. Designers can also display graphically both global and local views of the structure of hyperdocuments created. Hard copies of the hypertext structure and the associated HTML coding can be printed and kept for documentation as well as for maintenance purposes. A HTML-editor is also incorporated to provide designers with a menu to write HTML codes, without designers having to memorise the syntax.

Besides providing within HyperAT's authoring environment an automated, hierarchical structuring feature to represent node relationships, we also incorporated other authoring aids. One is a generated trace of created

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nodes during a HyperAT session to provide useful memory jots for designers, who may be interrupted during the HyperAT session or are simply confused over the nodes created. Another is a generated global map showing the structure of the hyperdocument with its constituent nodes. Clicking onto a node will bring up another map, with that node as the root node, providing designers with a fisheye view cancelling off other details not related to it.

We implemented into HyperAT some established website design principles and guidelines to illustrate that they can be automated in any authoring tool without designers having to worry about their implementation. To ensure consistency of presentation, every web page has a standard "look and feel" with navigational buttons at the top and bottom. Each web page contains essential elements like the title, author, date and time of creation, button bars which represent fixed links that allow users to move to content page, previous page, or next page. Links to other related web pages are also generated for each web page so that users can have a better understanding of how they can obtain related materials.

HyperAT also provides users with prospective information by generating the title of the pages users would move to if they were to click onto the navigational buttons. Because these prospective views that accompany navigational buttons are not hard-coded but automatically generated by HyperAT, no extra effort is therefore required from designers to ensure the inclusion and maintenance of this feature.

3.2 Usability Components

For the usability components, we incorporated features that help designers to better understand users and their browsing behaviour. Hence, apart from the basic editing facilities of create, edit and save, embodied within HyperAT is an experimental, authoring testbed which allows hypertext designers to carry out different modes of usability testing on the hyperdocuments created by HyperAT, all within the authoring environment of HyperAT: (3.2.1) structural analysis; and (3.2.2) real user evaluation.

3.2.1 Structural Analysis

In HyperAT, not only do we want to help designers structure information, we also want them to avoid structural inconsistencies and mistakes. HyperAT allows designers to analyse the structure by firstly, performing integrity checks on the nodes and links, and secondly, measuring the complexity of the structure of hyperdocuments. The simple metrics implemented to measure the complexity of the structure of the hyperdocuments are: (i) number of nodes; (ii) number of links per node; (iii) all possible paths from a given node; (iv) depth of a structure; (v) number of successors; and others can be added. This first-cut evaluation of the hyperdocuments alerts designers to take corrective measures as early as possible in the design process before it is too late.

3.2.2 Real User Evaluation

Real user evaluation is important because hyperdocuments are designed for users and not just what designers think or feel are important. Real users can be employed to evaluate hyperdocuments on the web with their transactions logged by the server log files, a view shared by [Berners-Lee 1995]. However, [Berners-Lee 1995] cautions that analysing the server log files takes time, if designers have to do that manually. Therefore, to help designers analyse these log files, HyperAT has a facility that parses and analyses server log files and interprets them, providing designers with useful insights into understanding users' browsing pattern. This otherwise untapped users' data can be useful design aids to pinpoint usability problems, and guide design decisions. In HyperAT, we also have implemented the following to measure: (i) frequencies of visits; (ii) clients' browsing information; (iii) pages visited; and (iv) clients visited.

3.3 Initial Evaluation

We carried out an initial evaluation of HyperAT to get qualitative results and impressions on the usefulness and usability of HyperAT as a web authoring tool by: (3.3.1) comparing websites produced by HyperAT and a

standard HTML editor; (3.3.2) getting feedback from experts; and (3.3.3) comparing HyperAT with some web authoring and management tools.

3.3.1 Comparing Web Documents

The main objective is to compare a website re-constructed by HyperAT with the original website produced by the original creator of the website using a standard HTML editor. Figure 2 shows a sample web page of the "Childnet International" website created by AtlasWWW, the original creator. Figure 3 shows the same web page created by HyperAT. It is to be noted that by using HyperAT, not only was the original "Childnet International" index page re-created but useful information for each web page to help user navigation were automatically generated. They include the automatic generation of text-labelled navigational buttons with prospective views, local views of related pages in relation to end-users' current page, table of contents providing a global view of the structure of the "Childnet International" website. For easier printing, a feature to print the website as a single document is also incorporated in this web page. Other automatically-generated information such as the date and time of creation, and creator of the web document, are also displayed in the "table of contents" web page.

We have shown that HyperAT is capable of creating any web document produced by any standard HTML editor. In contrast with the original web page, the web page generated by HyperAT contains navigational aids that are useful for effective user navigation. Because these aids are automatically generated by HyperAT, incorporating them into the web page would require little or no effort from designers. Designers can then concentrate on the content of the web documents, thus increasing the chance of producing better, usable web documents.

Childnet International's original Index Page

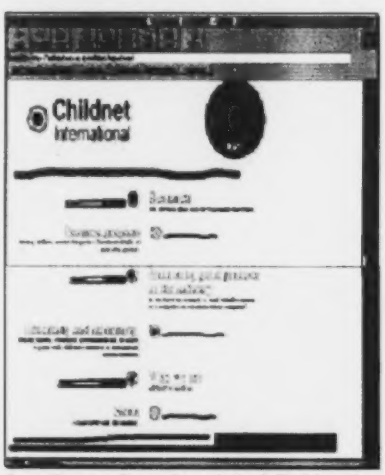

Figure 2.: A sample web page from the original Childnet International website

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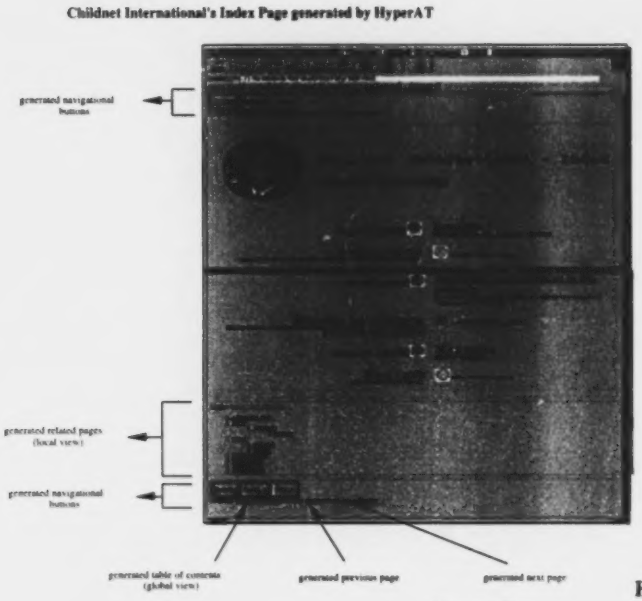
Childnet International's Index Page generated by HyperAT
generated navigational buttons
generated related pages (local view)
generated navigational buttons
generated table of contents (global view)
generated previous page
generated next page

Figure 3: Same web page generated by HyperAT

3.3.2 Getting Feedback From Hypertext Designers

We selected three subjects which consisted of two researchers and one lecturer to help us to evaluate HyperAT. The researchers worked at the Interaction Design Centre (Middlesex University), and their research project was to design and develop the Royal Society of Arts web pages. They were chosen because they were experienced in web design. The lecturer was from the School of Computing Science (Middlesex University) teaching undergraduates web design. He was chosen to take on the role of a less experienced designer and thus able to highlight potential problems novice designers may encounter.

Each of the subjects was given a 15-minute guided tour of HyperAT covering both the authoring and usability components of HyperAT. They were then asked to give feedback on whether the authoring features implemented in HyperAT were useful: creation of nodes and links; generation of map and structure; editing facilities; tracking and checking; testing and evaluation; and capturing end-users' browsing pattern. The subjects were also asked to comment on the usability of HyperAT.

The feedback gathered from the subjects indicates that HyperAT is a useful tool for designing usable web documents. The subjects indicated that all the features implemented in HyperAT are useful in helping designers develop usable web documents. They found the built-in functions for the creation of nodes and links useful. The subjects found the hierarchical structuring simple and intuitive. Because HyperAT separates page content from structure, the subjects felt it would help them concentrate on the content. The automatic generation of overall map and structure was a good feature to provide designers with a graphical overview of the web document. The subjects were also impressed that many processes in HyperAT were automated. These include the automatic structuring of web pages, generated "table of contents" and generated trace of created nodes. The subjects liked the different levels of usability testing HyperAT can perform. For example, facilities to check the structural inconsistencies and complexity were seen as helpful features. The ability to switch from the author mode in the HyperAT environment to the user mode in the Netscape environment was perceived as a useful feature. What makes an impression on the subjects is the idea that HyperAT is capable of parsing server log files, and analysing them to provide information about end-users' browsing pattern. They also liked the idea of HyperAT parsing and converting an existing website into a structure recognised by HyperAT.

With regard to the usability of HyperAT, it was difficult for the subjects to make any conclusive remarks without actually using the tool. However, the impression they obtained from the guided tour was that HyperAT appeared to be fairly easy to use, once they got used to working with it.

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The subjects also made some suggestions to further improve HyperAT. These suggestions basically involve making HyperAT more sophisticated in order to handle even more complex designer needs. One comment against HyperAT is that though the hierarchical structuring process to create nodes and links is intuitive, it may be too restrictive. The suggestion is to provide designers with meta-templates to select the different structuring processes. It is also suggested that different templates could also be provided for designers to select the different visual styles of web pages. Another feature that needs further enhancement is to allow for easier modification of the structure based on a "drag-and-drop" feature, and that updating could be done in real-time. To make the analysis of the transaction log files more useful to designers, it is suggested that the map should show the most common paths based on analysis of the transaction log files.

3.3.3 Comparing With Other Tools

The task of comparing HyperAT with other tools, be it commercial or research, is not an easy one owing to a plethora of tools available. We carried out a comparison of HyperAT with four selected tools (two commercial and two research) to highlight the benefits and limitations of HyperAT.

Compared with HyperAT, NetObjects Fusion is a more powerful page editor and site management tool, allowing designers to create, view and modify site structure graphically. Like HyperAT, it also gives semantics to the relationships between web pages. Although NetObjects Fusion provides analysis of the web documents, there is no attempt to integrate these analysis to make the necessary changes to the design of web documents. Microsoft FrontPage is another popular tool for managing websites and editing individual pages. Similar to HyperAT, it automatically generates scheduled inserts, table of contents, *etc.* Unlike NetObjects Fusion, it does not allow for direct alteration of site structure. It provides more utilities over the whole website such as spell checking and external link verification, compared to HyperAT.

WebWriter shares a similar view with HyperAT in that both are integrated systems for constructing web applications that support the creation of web pages. [Crespo & Bier 1996] explain that inspired by the HyperCard system, WebWriter allows designers to build an application as a sequence of web pages, where each web page can contain text, images, HTML forms, and the content that is computed on the fly by WebWriter scripts. HyperAT in allowing users to construct an application through a simple form-like interface automatically creates parent-child relationships between pages, instead of linear relationships captured by WebWriter. However, WebWriter's direct manipulation feature makes editing easier and less cumbersome compared to HyperAT.

Gentler [Thimbleby 1997] is a web authoring tool developed to overcome authoring difficulties encountered by designers. To make web authoring more systematic, Gentler uses a database of pages and a page layout language, as well as reliable design features including hypertext linkage and navigation. Like HyperAT, Gentler aims to reduce the cognitive load of authors, particularly by separating content and design, and by supporting quality control. Compared to HyperAT, Gentler provides a more powerful, flexible support for mathematical analysis of the hypertext structure. However, HyperAT has the ability perform more than just formal analysis of the hypertext structure. It has a program parser to read and analyse end-users' log files in order to understand end-users' browsing behaviour and goals. It is believed that by providing another way of conducting usability testing within HyperAT, designers may be able to gain useful insights into hypertext structural designs relating to cognitive issues from different angles based not only on formal analysis but on real users' behaviour.

4. Conclusion And Future Work

This paper described HyperAT, a research tool to help designers develop usable web documents. It argued for a move from treatment to prevention, from treating the end-users' symptoms to avoiding the bad design. Initial evaluation shows that HyperAT does a useful job as a research tool in exploring authoring and usability issues. Compared with other tools, a distinguishing factor of HyperAT is that besides providing the basic authoring facilities to produce web documents, HyperAT also delivers usability results to designers regarding any usability problems that might be detected during its analysis. Because both the authoring and usability components are found within HyperAT, it would be viable as a future enhancement to HyperAT to integrate the usability results into the authoring process to allow designers to make necessary changes to the web documents more easily.

Work with HyperAT involves a more extensive evaluation with different types of designers (e.g. novice, intermediate, experienced), as well as strengthening the usability environment it can offer to help designers build better, usable web pages. This will be our future work.

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Cognitive Apprenticeship in Training for Conceptual Modeling

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Abstract: We take situated learning as the starting point for designing a training tool for an undergraduate course on conceptual modeling for information system design. The purpose of the tool is to create training scenarios that provide the same kind of problems and complexity which conceptual modelers face in the 'real world'. School training of conceptual modeling has mostly consisted of problems of well-structured character with ideal solutions. In this tool we want the students to practice in scenarios that resemble authentic environments while receiving some support in critical phases.

The design of the tool is based on issues such as cognitive apprenticeship, authentic activity and language use, which have been in focus in the situated learning debate [Brown, Collins & Duguid 1989.], [Ramberg & Karlgren 1998]. Authentic activities as defined by Brown refer to "the ordinary practices of the culture" [Brown, Collins & Duguid 1989]. Our goal with this research is to evaluate how the cognitive apprenticeship learning model can be used to create complex and some what realistic exercise scenarios to facilitate training of the skills needed for conceptual modelers out in the 'real world'.

We have used video recordings to study the problem solving activities of experienced modelers. The modelers were asked to create a conceptual model corresponding to a textual domain description, while thinking aloud. In order to ensure some degree of authenticity we picked a problem domain that was unfamiliar to the modelers, and also let them interact with a person acting as stakeholder and domain expert. The purpose of the video recordings was not to find out the general strategy used by experts to solve these kinds of problems. It was rather to gather examples of how experts could go about solving problems like this.

A Scenario Environment

Currently, we are building a prototype with two major components. The first component is an environment in which problem scenarios, such as financial risk handling or airline flight scheduling, are presented. In the scenario environment, the student can explore the problem domain by reading hyperlinked documents, posing questions to simulated domain experts, and watching video clips illustrating important and problematic issues in the problem domain. In the scenario environment there is also a workspace where the students create the actual model by drawing objects, relations, and attributes, etc.

In the object-oriented community within system development the notion of patterns has been a buzz word the last couple of years, especially in object-oriented programming. Lately patterns have also become more popular in object-oriented design, by so called analysis or modeling patterns [Fowler 1997]. A goal of the course is to make students create general and reusable models and one way of doing this is by using patterns. Here we view analysis patterns as a language, which the students should practice to use, not as special constructs that they should memorize. Therefore we provide a pattern library from which the students can pick patterns to use in the workspace in their solutions. The patterns will also be accompanied by example ways of how they are used. By integrating the pattern library with the workspace we let the student use and modify patterns from the pattern library in the workspace and thus increasing the students' active use of the patterns.

Apprenticeship and Scaffolding Features

The second component includes some apprenticeship features and scaffolding support by providing 'tracks' illustrating how experts proceeded in solving the same problem, a pattern library, supported dialogs, and support for the workspace activities. One general feature of the workspace is that the possible ways of modifying, adding,

and removing objects, attributes, relations, etc are restricted, i.e., only a pre-specified number of new objects can be created and the patterns can only be modified in certain ways. This makes it possible to keep track of where the students are in the modeling process and makes it more manageable to provide the apprenticeship and scaffolding features.

We have used the video recordings in two different ways to ensure some degree of authenticity and to provide scaffolds for the students' problem solving. Firstly, to be able to show learners how experts go about solving similar problems. When learners run into a problem they can be shown video clips of how the experienced modelers proceeded from the point where the student currently is. Secondly, we used the video recordings as a point of departure in the design of the system in several ways. One way was to create the master problem solving tracks, which students can follow if they feel they need guidance on how to solve the current problem. The tracks consist of 'steps', each corresponding to different actions taken, or decisions made, by the experts during problem solving. At each step the student gets to model the same parts as the expert did at this point. When the students are following a master track we can give feedback on solutions or partial solutions based on where the students are currently at in the track. We also use the recordings to extract critical points in the problem-solving process. We have seen that the experts all come to some common points of insight, e.g., that some generalization should be made or that some object should be split into several. We intend to use these insights to create 'stations' that the students should pass when going through a scenario. The purpose of these stations is to make it possible for students that do not follow any of the tracks to still get support in critical or problematic phases.

Language Use

Since one of our goals of this research is to increase the students' active use of language [Ramberg & Karlgren 1998], we have also used the video recordings to study the language experts use when modeling. We have extracted critical questions, statements, and expressions that the experts used in the conversations with the domain expert and when thinking aloud. From these extracts we will construct dialogs which the student can use when exploring the problem domain. In the dialogs the students will choose from topics and subtopics and pick questions that they want to ask the domain expert. By using this approach we can include nonsense questions and irrelevant topics so that the students have to make well considered decisions when picking questions. This also gives the students implicit guidance since relevant questions and expressions are provided in the dialogs. By increasing the number of questions and topics so that more issues have to be considered we can also fade the support in these dialogs.

Future Work

After completing the final prototype and designing the scenarios we will carry out evaluations of the learning effects of the prototype. One critical aspect of the evaluation is that in order for the evaluations to give meaningful results it is important that the prototype is not too 'prototypical'. Thus, the tool has to be rather complete so that the 'prototypicality' does not interfere with the learning experience of the student. The student has to be able to work with the tool for an extended time period since the skills they are supposed to learn are complex and require active engagement - as emphasized by situated learning - in the modeling process.

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Kids Talking to Kids

This poster session will look at five years of technology based multicultural education programming at the Baker Demonstration School of National-Louis University. Beginning with e-mail systems, the children at Baker have regularly communicated with children of various ages from around the world. The program started with e-mail and Internet relay chat and moved into MUSHing and creating multia media on the world wide web.

The Baker Demonstration School faculty began a new project in 1995. In a collaboration among the Latin teachers, the Social Science teacher, the Technology Coordinator, and the systems administrator, a MUSH was established in the form of Imperial Rome. This project, which continues to this day, focused on recreating the environment of Rome in as much detail as possible. Visitors to Rome interact with other visitors as well as electronic personas who fill many of the roles of daily life. Students from around the world participated in the development and construction of Rome, and many more have established Roman identities and have become inhabitants of the city. This project allows for learning experiences in nearly all subject areas through participation in a simulation of daily life.

Integration of a Three-Dimensional Graphical Viewer with a Web-based CAI System

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Abstract: In this paper, we propose a new mechanism to tightly integrate a 3-D viewer with a Web-based CAI system and describe the developed prototype system. Both the 3-D viewer and the Web-based CAT have learning goals. The system estimates how much a learner understands each learning sub-goal and gives appropriate feedback, such as supplementary lessons, according to the learner's comprehension level. Hence the integration of both systems, 3-D viewer and Web-based CAI, can provide learners with a rich educational environment.

1 Introduction

Three-dimensional (3-D) computer graphics are effective for education and training. By observing and interacting with 3-D objects in a 3-D virtual space, learners can achieve intuitive understanding of 3-D objects and master the operation of machinery without any danger[Kato 1996]. Practical exercises using 3-D computer graphics also reinforce knowledge learnt in systematic lessons beforehand. A systematic presentation of learning materials can be provided by web-based computer-aided Instruction(CAI) systems[Nakabayashi 1995]. Hence, the integration of 3-D viewing with Web-based CAI can provide learners with a rich educational environment. In this paper, we propose a new mechanism for tightly integrating a 3-D viewer with a Web-based CAI system and describe the developed prototype system.

2 Learning Sub-goals

Each piece of courseware in a typical CAI system has a specific learning goal, which can be iteratively broken down into contributing sub-goals. Thus, in integrating a 3-D viewer with a web-based CAI system, it is appropriate for the courseware creator to define learning sub-goals for both systems. For the 3-D viewer, the sub-goals should include (1) the operations that a learner should be able to do in the 3-D space, (2) the sequence of the operations, and (3) the significance of the operations.

For each 3-D activity designed to accompany the web-based CAI course, the relation between the two environments in terms of the learning goals must be defined. The relationship could, for instance, be defined as follows.

- The Web-based CAI system has pre-defined learning sub-goals for each 3-D activity and is able to determine whether the learner understands each of the sub-goals.
- The Web-based CAI system interacts with the user during each 3-D activity, giving hints, advice, or supplementary lessons.

3 Proposed Mechanism

Given the considerations above, we developed the following approach:

- The 3-D viewer presents and manages learning sub-goals.
- The Web-based CAI system provides Web pages explaining each sub-goal.
- The CAI system launches the 3-D viewer from the explanatory Web page, and the learner performs the activities therein.
- The 3-D viewer determiness whether the learner understands the learning sub-goals and reports its findings to the CAI system.

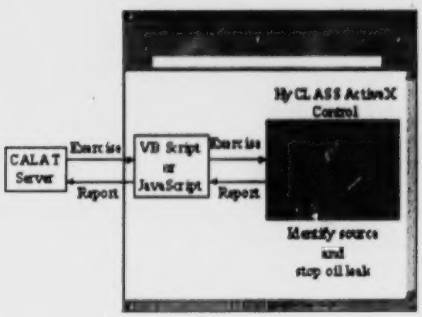

Figure 1: CALAT and HyCLASS systems

- From the report sent by the viewer, the CAI system can determine how much the learner understands. It can then provide supplementary lessons or other feedback, as needed.

4 Implementation

To evaluatie the fasibility of our proposed method, we are currently developing a prototype consists of a 3-D viewer, HyCLASS, and a Web-based CAI system, CALAT[Kato 1996][Nakabayashi 1998]. We are also developing an example courseware.

The goal of this courseware is to understand about oil leaking from a car and how to stop it. The sub-goals are (1) the operations needed to identify the source of an oil leak and fix it, (2) the sequence of operations, and (3) the principles of the operations. The main principles are

1. the places where oil leaks are usually muddier than other places, and
2. the fill spout and drain plug are the most likely places where leaking occurs.

The relationship between the CALAT and HyCLASS systems is illustrated in [Fig. 1]. Both display information to the learner via the CALAT client, a Web browser. CALAT introduces the learning materials. For example, it explains the sub-goals. The HyCLASS ActiveX control monitors the commands entered by the learner, then analyzes them to determine whether he or she understands the sub-goals. For example, if the learner replaces a clean plug, HyCLASS judges that he or she does not understand the first principle. When control is returned to CALAT, ActiveX control sends a report to CALAT in VB script (or JavaScript) by using the HTTP POST method. For example, the report might say that the learner found the leak but could not fix it.

5 Conclusion

We have integrated a 3-D viewer with a Web-based CAI system. The viewer presents and manages learning sub-goals. It determinse whether the learner understands the sub-goals and reports its findings to the CAI system. Because this system has the features of both a 3-D viewer and a Web-based CAI system, it should be effective for education and training.

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A User-Extendible and Customizable CVE Framework

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Abstract: We argue in another contribution that Collaborative Virtual Environments must be built on a highly extendible and customizable framework. In this short paper, we describe a part of the architecture of a prototype CVE designed to satisfy this need.

1. Introduction

Collaborative Virtual Environments or CVEs are software environments that emulate and extend a variety of properties that allow us to work, play, and socialize in the physical world. In our opinion, CVEs represent the metaphorical foundation of future computer networks that goes well beyond the present document-centric metaphor of the web. We have listed a number of properties that we consider essential in another contribution [Tomek 98] and mentioned that customizability and extendibility are among the most essential ones. Customizability is necessary to satisfy individual user's preferences, and extendibility is necessary because all possible uses of CVEs cannot be anticipated – just as possible uses of natural environments.

Over the past two years, we experimented with a variety of uses of two CVEs, one built as an extension of a CVE called Jersey developed elsewhere [Tomek 98], and one developed as a prototype in our group. In the following, we describe and illustrate the architecture of the second environment.

2. An Extendible Customizable Design

The goals of our Smalltalk-based [Tomek 98] client-server design were to make the environment extendible and customizable at run time, to offload the server as much as possible, and to do as much of processing as possible on the client. Customizability and extendibility were to be achieved while ensuring sufficient security.

The simplified object diagram in Figure 1 (included only in the CD-ROM version) shows the principle of the design of the framework, without showing any of the CVE-specific functionality such as agent objects, locales, communication, and other features. The following explains the principles of this architecture:

The server is the executor of messages received from clients as well as the database holding the CVE universe with its agent, locale, object, and other information. Each functionality, such as universe navigation or communication, is implemented by a specialized plug-in. Plug-ins come in two varieties – leaf plug-ins which implement atomic functionality, and super plug-ins which combine lower level plug-ins to obtain richer functionality. An example of a leaf plug-in is the navigation plug-in that allows a user to move from one locale to another. An example of a super plug-in is a 'base plug-in' which combines navigation, communication, and other essential leaf plug-ins.

Each plug-in has a server component and a client component. The server component performs the plug-in's functionality on the server side, the client plug-in performs the client's counterpart and resides on the client. The server contains the whole library of the definition of all classes of all existing server-client plug-in pairs, as well as the instantiation of all the server side plug-in classes. The server is thus ready to perform the functionality of any plug-in at any time, and ready to download the definition of its client counterpart to the client.

Communication between the server and the client is, in general, in terms of messages and arguments packaged as binary objects; this considerably compresses the volume of the necessary network traffic. All

communication, both on the side of the server and on the side of the client passes through a dispatcher object whose function is to determine the intended plug-in receiver of the object package and pass the object to it. Due to the nesting of plug-ins, this process may go through several levels before the package reaches the destination plug-in. At this point, the plug-ins executor object determines which of its components, if any, should receive the message and passes the message to it. Downloading of new plug-ins and their updating when a new version of a plug-in becomes available on the server follows the same pattern.

3. Conclusion

We have implemented a prototype of an extendible and customizable framework for a Collaborative Virtual Environment. By virtue of the fact that Smalltalk is used to implement the environment, and the fact that the client includes the complete Smalltalk image, the user can download plug-ins and keep them on the client machine, and customize his plug-ins, including their user interface and functionality, at run time. New plug-ins – both their server and client sides – can also be developed and installed at run time without the need for recompilation.

After implementing a prototype framework using the described architecture, we are now investigating other approaches such as separating the data from the processor and holding it in a separate object-oriented data base on the server, using a web browser as an alternative user interface, and other options. Alternative user interface media including audio, video, and virtual reality will also be investigated to overcome certain observed problems due to the very restrictive nature of our existing text-only user interface.

We have used the alternative CVE mentioned above in several courses on software development, and in the development of both CVEs. We hope to use a new CVE designed on the basis of these two experiences in a large course starting in the fall.

Acknowledgements

The implementation of the prototype was the work of Dave Murphy, an MSc student in our school.

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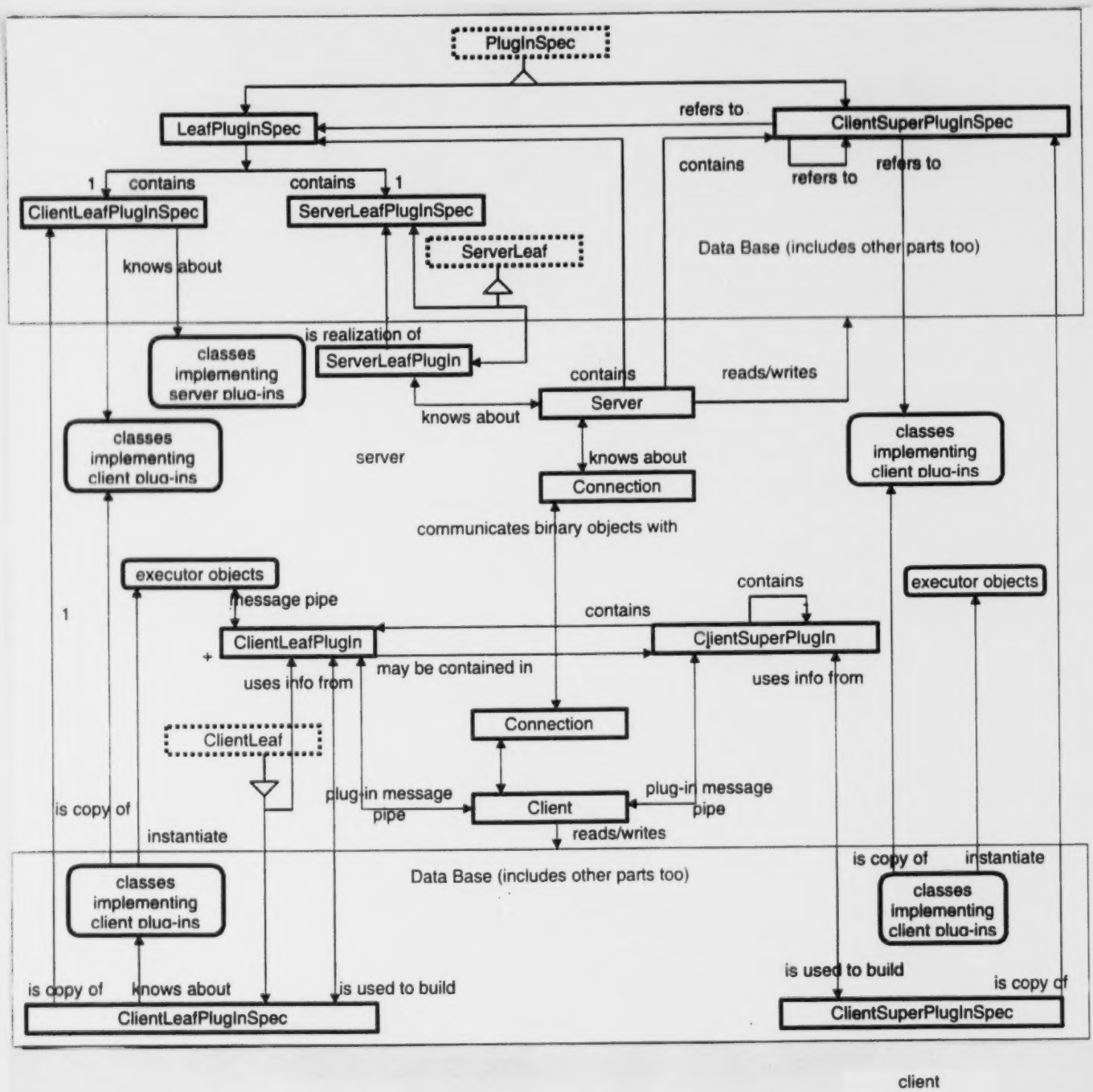

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General Properties of Collaborative Virtual Environments

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Abstract: Collaborative Virtual Environments (CVEs) have now been in use in various areas for almost two decades. Up to now, they have been characterized by a diversity of features without a common underlying framework and an accepted understanding of their purpose, features, and components. We argue that it is time to start analyzing the accumulated experience and formulating a general CVE model.

1. Introduction

Collaborative Virtual Environments (CVEs) have their origin in MUDs – Multi User Dungeons and Dragons games and their variations played on computer networks since the late 1970's. From their recreational origins, these environments evolved into applications in education, office automation, engineering team work, and other areas. To protect the development of these new environments from the unfavorable connotation of the term MUD among management and administration, MUDs developed for 'serious' uses are now usually referred to as Collaborative Virtual Environments or CVEs; this is the term that we will use in the rest of this paper.

Advocates of CVEs claim that current uses of computer networks are lacking by emphasizing their use to construct, structure, edit, and access to information, and providing only minimal support for user-modifiable support for collaboration and socialization. After all, access to information is only one dimension of human lives. The argument is that CVE's can extend the information dimension and provide an environment that emulates the real world with its customizability, extendibility, and social navigability.

The growing number of publications and conferences dedicated to CVEs and related subjects shows that interest in CVEs is growing. We argue that is it time to try and organize the concepts behind CVEs in a similar way that accumulation of experience with hypertext environments led to the creation of widely accepted standards and the florishment of hypertext-based computer networks. In this paper, we first list the characteristic features of CVEs and then cover each category of features in more detail. We then describe an environment that we designed to support its framework.

2. General features of Collaborative Virtual Environments

The specifics of the medium of the user interface are not essential. Many existing CVEs use a purely textual command line interface, some have graphical user interfaces, a few use 2D or even 3D graphics with animation, audio is increasingly common, and some implementations use digitized video. Most current implementations are client-server Internet-based applications, an increasing number use the Web, and some are designed for intranets or operation on internal TCP/IP based networks.

The CVE concept originated as a model of the real world in which people coexist in buildings, rooms, and other physically separated spaces, move between them, communicate, use tools to accomplish tasks, move tools and artifacts from one place to another, and so on. This model is a good starting plan for

the exploration of the dimensions of a general CVE environment. We propose the following as a list of characteristics of CVEs that can be found across the union of their existing or proposed implementations:

- Support for creation and destruction of rooms, places, or locales - all more or less equivalent concepts referring to computer-supported scopes restricting communication between users and allowing storage of persistent objects and tools. In the following, we will use the term locale to refer to this concept of communication/object space.
- Nesting of locales in a fashion similar to the nesting of rooms in floors, buildings, campuses, etc.
- Navigation between locales. Users can move from one locale to another.
- Inter-user communication of various kinds ranging from synchronous communication involving all or only selected users present in a locale, to asynchronous communication via bulletin boards located in locales.
- Ability to add 'agents' representing human users or software agents.
- Ability to create groups of users playing specific roles for the purpose of accomplishing a task.
- Ability to define processes to be followed in accomplishing a task.
- Ability to use tools to generate persistent objects.
- Ability to define policies - ways in which tools or locales are used.
- Ability to create objects deposits them in a locale, pick them up, and move them to other locales.
- Support for an overall authority that controls the operation of the CVE, allows new users, provides authorizations, and regulates users' behavior.

Beyond these CVE-specific characteristics, CVEs should also have the following general features, all of which reflect our daily experiences in the real world, which is, after all the basic CVE model:

- Interoperability. CVEs should allow users to use software such as web browsers, word processors, and spreadsheets, existing outside the framework of the CVE itself.
- Extendibility. The characteristics listed above imply that a CVE is by definition extendible: Users can create rooms, groups, objects, agents, processes, policies, add tools, and so on. Beyond this, the software framework supporting a CVE should itself be easily extendible, preferably at run-time without having to bring the environment down for recompilation.
- Ability to allow individual expansion and creation of customized user interfaces and other tools. This requires some form of a scripting or programming language.
- Distributed robustness - ability to withstand localized modifications, even when they don't work.
- Security for the whole environment and its individual users.

3. Features required to support collaborative spaces

The concept of a locale covers any well-defined scope. In the real world, a locale can be mapped to a room, a floor in a building, a building, a campus, and so on. In other words, the CVE implementation of a locale must allow nesting to an unlimited depth.

A user creates a locale and becomes its owner. The original owner may, in turn, confer ownership on a whole group of users. Corresponding to the real world and the needs of CVE, a locale may have associated with it a group of users with specialized roles of which being the owner is only one. Other roles include functions such as managers, observers, curators, instructors, assistants, students, or visitors. CVE users who are not members of the group do not have access to the locale and access of users in the group may be restricted in ways defined by their roles.

A locale may also have one or more processes associated with it. To give an example from the physical world, a person entering a theater must show a ticket to the usher who will show him to his seat.

Users may equip locales with tools or artifacts and these tools will stay in the locale until removed by an authorized user. As an example from the real world, a classroom may be equipped with a white board, an office with a desk and a garbage can, a meeting room with a white board and a camera, a

steno pool with word processors, and so on. In the real world, one can distinguish various types of rooms such as classrooms, conference rooms, reading rooms, and so on, and each of these has certain shared characteristics in that it is equipped with certain standard tools and has certain processes associated with it. Since it does not make sense to recreate a new classroom every time one is needed, it is desirable to be able to create locale templates (blueprints), possibly with nested levels of abstraction. As an example, a room for teaching languages might have all the features of a classroom plus tape recorders for playing tapes, and some additional processes that the classroom template does not have. With room templates, new locales of a standard kind may be created as specialization of locale templates.

Another aspect that templates can support is clustering of lower level locales. As an example, one might wish to be able to create the template of a course cluster containing a classroom, a consulting room, and an assignment repository, or an engineering team cluster with a room for the team manager, offices of individual developers, a meeting room, and a documentation room.

To be distinguishable, locales must at least have names. This, however, is not in general enough and locales should thus also have descriptions. Besides explaining the purpose of the locale, a description also helps to give the locale a 'personality', contributing to its being a 'place' where people meet rather than a mere sterile 'space' .

A question debated by some CVE designers is whether an individual should be allowed to be simultaneously in more than one location. We argue that this should be allowed because it may be useful and has counterparts in the real world. As an example, a person participating in a conference call may at the same time be sitting in a meeting. As default, users should be allowed to be simultaneously in multiple locales unless the locale explicitly disallows it.

This point brings up the question of inheritance of locale properties. As an example, if being in several locales at the same time is disallowed in a particular 'building' should it be allowed in the 'rooms' of the building. For reasons of consistency and convenience, our position is that inheritance should rule but can be overriden.

4. Features required to support navigation

CVE users must be able to move from one locale to another, both in a 'horizontal' sense (such as from one room to another) and a 'vertical' sense (as in moving from a building level to a room level. Whereas it may be important in some contexts to support navigation with real-world constraints (based on the notion of the properties of the physical space), restrictions of the physical world may be unnecessary in other contexts. As an example, in a CVE implementing the game of Dungeons and Dragons, the connectedness of rooms, caves, and other locales is an essential component of the game, whereas in a work environment where locales play the role of project meeting rooms, the important thing is to be able to move from one place to another but the notion of topography may be irrelevant. Consequently, individual users may want to create their own view of the CVE, with their own topography - or without any topography.

To be able to support both a topography-less and a 'topography-full' perspective, it must be possible to create a locale supporting one of the two representations and controlling navigation in a corresponding way. Even in a topography-full space, it may be desirable to allow a user to jump from one locale to another (an action known as teleporting) without passing through intermediate locales. This is particularly natural if the space is represented in the form of a map supporting a direct manipulation user interface.

5. Features required to support individual participants and groups

A CVE agent may be either a human user or a software agent. A CVE agent has a name, a description, and a list of group memberships. Just as most people in the physical world have a home, most CVE agents will have a home locale. An agent will also have a set of possessions that he carries around. In the case of a software agent, the agent satisfies the rules of an agent interface that allows it to

communicate with other agents and with the environment. New agents are added to a CVE by a member of the group of administrators who can also remove them from the CVE. The conditions under which this happens are given by the nature of the environment.

Collaboration involves groups of users and the concept of a group is thus essential. A group has a name, a description, a list of roles, and a list of users playing the individual roles. A group may also have one or more processes associated with it. As an example, a group of players of a MUD game might have certain induction rituals required when a new user wants to join a group, and a student may only be admitted into a course if he passes certain examinations or satisfies certain prerequisites.

Just like locales, groups are created by a user who becomes the owner of the group and can specify its features and its members. Also similar to locales, groups naturally lead to the concept of a group template - a description of a group devoid of membership. Group templates may then be used either to create more specialized templates or to instantiate a 'real' group with members.

In the real world, people are organized into hierarchical structures that sometimes overlap. As an example, a university is divided into faculties which are divided into departments, and at the same time, faculty members serve on a variety of committees and subcommittees. To support collaboration, it is thus necessary to allow group nesting in the same way that locales are nested. Members of groups may thus be individuals or other groups.

6. Features required to support communication

Communication is one of the essential features and attractions of CVEs. As in the real world, all users present in the same locale should hear one another under normal circumstances. At the same time, occupants of the same locale should be able to talk (whisper) to only one or a selected group of other occupants. In this context, we use the term 'group' in the sense of a 'discussion group', a collection of users formed for the purpose of communication rather than in the former sense of a group introduced above. Creating a formal group for the purpose of private discussion and possibly creating a locale on the spot for the purpose of private communication is, of course, also possible. The concept of a discussion group is useful in another context as well - to support the equivalent of a conference call involving several CVE users who may be in different locales.

In some situations, communication may not be fully symmetric. As an example, a group of students writing an examination may be observable to the examiner from another room but the students may not be able to see or hear the examiner. Setting up locales allowing asymmetric communication should thus be possible.

In addition to synchronous communication in which all authorized occupants of a locale or a discussion group 'hear' everything 'said' by every participant and can themselves contribute, asynchronous communication must also be supported. This notion corresponds to e-mail, bulletin boards, stick-up notes, faxes, and recordings in the real world. Some of it (such as e-mail) should be supported globally across the whole CVE, other forms (such as bulletin boards) should be supported by local tools.

In the case of nested locales, the question arises whether occupants of lower level locales should automatically participate in communication in higher level locales. Such an arrangement would be both inconvenient and unnatural and should be impossible by default. Note, however, that multi-place presence allows it when explicitly required by users.

One must also ask about communication in nested discussion groups. In this case, communication in an upper-level group will include all members of the group but a distinction must be made in the user interface to allow lower-level groups to have private communication that excludes higher-level groups.

An important feature of collaboration is the notion of awareness: A user present in a locale must be able to find who else is in the locale, whether they are active or passive, who is entering, and who is leaving. Awareness is one of the more difficult aspects of CVEs to support, and video cameras on each user's desk may be the best way to support it.

Awareness raises one important issue that extends to many other aspects of CVE operation – event sensitivity. As in the real world, many actions in CVEs require notification of agents that registered

interest in these events and this can only be supported by event-based operation. Actions such as agents entering or leaving locales, objects being taken or deposited, new objects or artifacts being created or destroyed should all create event notification.

7. Features required to support tools

A tool is a software component such as a word processor, a compiler, a bulletin board, or a white board. In a CVE, we consider anything above the CVE framework to be a tool. In analogy to the real world, tools may also be composed into more complicated tools to any level of nesting.

In single-user desktop environments, a tool may impose a certain order of actions that may be applied to it or certain rules. The software generally imposes these restrictions. In CVEs, the situation is more complicated because a tool may operate under different constraints in different locales, and because the potential of simultaneous access by many users may have to be coordinated. In an electronic classroom in which users may post their contribution on a shared white board, for example, it is advisable to allow only one user at a time to post and queue all other users. Another example is the use of a whiteboard in a classroom, which is generally controlled by the instructor. Restrictions such as these can be enforced by the concept of a policy [Cortes 96].

8. Features required to support processes

We consider the concept of a process to be equivalent to the concept of workflow: A process prescribes how certain activities are scheduled in time, space, and among people. Some examples of processes are the rules guiding a meeting (approve minutes, deal with matters arising from minutes, and so on), an exam (sign log sheet, get question sheet, answer questions, return answers, leave room), and so on. It has been observed that processes may be more or less rigid, that there are almost always exceptions, and that processes may evolve. The mechanisms for describing and enforcing processes should be able to support any degree of flexibility that may be desired.

Process may obviously consist of sub-processes and should therefore be composable. Processes are also often specializations or modifications of other processes and the concept of a template thus applies.

Processes are naturally associated with roles. As an example, a purchase order passes through the hands of several different kinds of people before the purchase is completed.

9. Features required to support extendibility

Although we compiled a rather long list of features that we consider sufficient CVE characteristics, an exhaustive list can never be created because of the unlimited possible CVE uses. As a result, CVEs must contain built-in features to support unlimited extension, and allow users to specialize and to generalize existing features at run time. A scripting programming language of the kind provided in Lambda MOO is a step in this direction but it does not go far enough. In particular, Lambda MOO itself is not written in its scripting language and deeper modifications using the scripting language are thus impossible. Ideally, at least one of the scripting languages available to the user should thus be the implementation language itself.

10. Software agents

Software agents, whether 'intelligent' or 'dumb' can play very useful roles. In an earlier project [Tomek 98], we used agents to fake the lack of event-driven operation (agents regularly visiting project rooms and collecting the latest versions of documents), to maintain a help data base and provide help and help mediation to users, to help with meetings by enforcing rules such as hand raising and turn taking, to

deliver newsletters to subscribers, and so on. It is worth noting that since the concept of an agent evokes a personality in a physical space, locating agents in CVEs is perhaps the only consistent metaphor for agent deployment.

Much has been written about software agents and we will not elaborate on this concept for lack of space.

11. Case scenarios

As a minimal verification that the list of features presented above is reasonably complete, one must consider scenarios of possible uses of CVEs in selected well-defined contexts. Three examples are a CVE-based university, a gaming environment, and a CVE software development environment. For lack of space, we cannot perform this step.

12. Conclusion

We argue that CVEs are the logical next metaphor in the evolution of computer networks and that it is time to discuss the dimensions that characterize them, and develop frameworks that implement these dimensions. Our list may be incomplete but we offer it to start a discussion. While incomplete, the list is also very ambitious which should not be surprising since social networks supporting human cohabitation are an order of magnitude more complex than document networks characterizing computer networks today.

We have proposed that the discussion of CVE dimensions can start with an ad hoc listing of their properties. The completeness of this list must be verified by practice and by examining whether CVEs designed along these lines can satisfy typical scenarios found in social contexts such as education, work, and socialization or recreation. Since the list of possible uses is unlimited, one of the essential features of CVE architectures must be their extendibility. We present the prototype of a part of the design of such architecture in another paper [Tomek 98].

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On-line with the Future: Web-Based Program Development at the University of Central Florida, Designing a University for the 21st Century

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Abstract: Faculty, administrators and support staff are reinventing formal education at the University of Central Florida through the World Wide Web and instructional design. Campus services and degree programs are being re-engineered and invented to extend flexible educational opportunities to serve diverse students and faculty. Preliminary research results indicate a high adoption rate among faculty and students for learning on-line through an institution-wide initiative. Scalability issues are the foremost challenge to administrators and support staff to provide quality web-based learning environments and services as more faculty and students get involved in teaching and learning on-line. This paper describes the model, process, barriers, benefits, lessons learned and future direction of UCF's web-based program development.

Background

Central Florida is one of the fastest-growing regions in the nation. Orlando is a center for high technology and space-related industrial development in addition to being one of the world's most popular tourist destinations. UCF is a metropolitan university. The average student age is 26 and only 2,000 students live on campus. The University is just over 30 years old and serves approximately 29,000 students.

State of Florida projections show that UCF will nearly double in size within 20 years due to increased numbers of high school graduates, adult returning students and a workforce that requires lifelong learning. These projected demographics as well as the change in our nation from an industrial base to an information base, and advances in information technology are all forces re-shaping the educational landscape in Central Florida (Allen, Hartman & Truman, 1997).

UCF is aggressively developing distributed learning programs that use the World Wide Web to meet the needs of its diverse students and faculty. Distributed learning is an alternative paradigm that uses computers, networks and on-line information so powerful that a new pedagogical model is emerging to change the content and process of education (Dede, 1996). At UCF, this pedagogical model is driving the re-design of our university for the 21st century. Networked-focused learning is resulting from the exponential growth of the Internet where student-initiated data gathering and interactive communications make learning potential incomprehensible (Barker & Baker, 1995).

The university has chosen to employ the strategy of asynchronous learning networks (ALN) as a primary approach to create distributed learning to ease existing and projected shortages of classroom space, and meet the need to maintain quality within available resources. Delivering degree programs on-line requires

access to a reliable campus infrastructure and services. Identifying needs and evolving processes requires genuine experimentation. The willingness to change among universities is required (Katz, 1997). It was through the willingness to experiment at UCF that the term "distance learning" was soon replaced with "distributed learning." ALN creation at UCF using distributed technologies has made Simonson's prediction a reality: "distance" as a definition will become relatively unimportant (1995, p12).

Key Ingredients for Redesigning a University

Enabling the ability to teach and learn anytime, anywhere with institutional responsiveness requires a three components: 1) administrative leadership, 2) the technical and workforce infrastructure to fulfill the mission and 3) faculty willing to risk experimentation. The campus infrastructure must also have departments aware, alert and ready to serve students and faculty asynchronously through collaboration with other units. This type of campus responsiveness doesn't happen overnight. A change process must be facilitated to create a campus-wide cultural change. Thoughtful design of the technical infrastructure and staff requirements must come from administrative support and vision. Systematic faculty development enables faculty potential creating a critical mass of transformation. Assessing outcomes for continuous improvement insures cost-benefit gains. Achieving a multifaceted response to consumer demand for increased access, improved quality, and reduced cost of higher education is the concept of a virtual university (Twigg & Oblinger, 1996 p. 21).

Provision of these key technical and training ingredients is not enough to develop high-quality web-based programs and services. Expert facilitation must also take place through administrative leadership to catalyze positive change on an institutional level. A by-product of effective distributed learning using asynchronous techniques is learning communities which mobilize change. The factor enabling mainstream faculty and students to succeed as on-line teachers and learners is facilitated collaborative learning. In successful distributed learning, electronic communities of scholars develop on-line among individual classes, but also among faculty developing courses across colleges and disciplines, web developers and researchers.

Barriers to Formal Education on the Web

Faculty willing to experiment are essential to developing successful web-based learning environments. Some factors that prevent faculty from pursuing technological innovations are: fear of change, fear of time involved, fear of appearing incompetent, fear of technobabble, fear of failure, not knowing where to start, fear of making bad choices, fear of typing, and the fear of reprisals and rejection (Williams, 1996). In addition to these barriers are how efforts of faculty to develop high tech classes often are unappreciated and frowned upon" (Auter & Hannah, 1996). Making data collection part of the course development model is one UCF strategy to compensate for time required to develop instruction and teach on-line.

Provision of adequate campus infrastructure ensures equipment, software and production support to prevent faculty from feeling frustration if they have made a sincere commitment to teach on-line. "If we are to serve them (the faculty) well, we need to show them how the computer can help them do what they do anyway... technology should offer them choices, not requirements" (Killian, 1997). Achieving choice offerings will create self-propelled learners pursuing ambitious, but realistic goals. Albaugh (1997), cites a book published by Larry Cuban in 1989 called Teachers and Machines: the Classroom use of Technology since 1920, where adoption of technology among teachers is achieved when it helps them do better what they are currently doing. Albaugh warns of the danger of reinforcing the status quo by using technology as an aid to teaching instead of allowing the use of technology to transform teaching (p. 5). Cloning the classroom is a common mistake when creating on-line environments. Ben Shneiderman (1997) also warns of the temptation to use "mimicry" when considering what computers should be designed to do. Most often, computers mimic human performance rather than going well beyond human performance.

Administrative leadership for institutionalization of faculty development is essential for creating high-quality web-based programs. Daigle and Jarmon (1997) state that technology-focused faculty development programs should have a goal to become part of the fabric of the institution and agents of its transformation. The barriers of time and space should not interfere with faculty development programs. Faculty development that has significant investment in the human capital infrastructure results in a *multiplier effect* that involves large numbers of faculty regardless of age, interests, discipline or talents. Faculty should be encouraged to become self-sufficient, just in time, lifelong learners. Faculty development programs should be replicable with baseline measures. The program should be connected to the university's strategic plan and the program should have a business plan for measuring effectiveness (Daigle & Jarmon, 1997).

UCF Course Development Model: Techranger v. Loneranger Approach

The "Loneranger", or craft approach to developing on-line courses occurs in many institutions as faculty, student webmasters and a few isolated departments or colleges work in isolation. The Loneranger approach may yield good results, but the institution's ability to scale efforts and maintain quality courses is difficult using this approach. Creating consistent courses within on-line programs is made possible at UCF by using Techranger or professional approach, made up of student and full-time staff dedicated to producing multimedia materials for faculty teaching on-line. Scaling the Techranger approach requires facilitating a train the trainer strategy to help colleges and departments create an administrative "safety net" to support faculty versus the craft approach of a single faculty member going it alone (Sorg & Truman, 1997).

Over the past two years, UCF has made significant investments in key ingredients: technology infrastructure, faculty and student support services, and organizational development to support both regular campus instruction and the asynchronous learning initiative. The Division of Information Technologies and Resources was formed in early 1995, bringing together the Library, Computer Services (academic and administrative computing), Telecommunications, and Instructional Resources into a single administrative unit. The position of Vice Provost for Information Technologies and Resources was created to head this division, which reports to the Provost and Vice President for Academic Affairs. In July of 1997 a new unit was formed to create professional ALN courses and provide related faculty and web research and development support.

UCF Course Development Process

After faculty successful complete a six-week course to learn to teach on-line, high quality web-based learning environments are created through a team that consists of subject matter experts (faculty), instructional and graphics designers, programmers, and cybrarians. At UCF, faculty are not required to possess knowledge of HTML programming or multimedia production to produce on-line courses. Rather, institutional efforts focus on faculty development teaching instructional design for Web-based learning environments (Truman & Sorg, 1997). Technology-based formats such as ALN change the division of labor which are rapidly creating a new class of instructional personnel who support faculty (Jones, 1996). Ten years from now it is predicted that course development teams will be the typical approach to develop curricula and courses (Twigg & Oblinger 1996, p. 14).

Course production is best done when the faculty have taken sufficient time to examine their pedagogical goals. Re-engineering the average course using UCF's faculty development model and team-based process takes one semester. Many schools do not require faculty to learn instructional design to make on-line environments, which may lead to unpredictable results and miss the opportunity to transform the curriculum. Robert Stephens (1992), conducted a follow up study of 170 colleges and universities to examine the role of planning, delivery, evaluation and content selection. Stephens found that instructional design principles are being under utilized in the development, delivery and administration of faculty development programs. Collis and Bremen (1997) used an instructional design class at the University of Twente in the Netherlands for "pedagogical engineering" an on-line course. In addition to using the jigsaw method of distributed class work among the design students, formative evaluation was used as a key to integrating theory and practice (p. 10).

Benefits of UCF's Course Development Process

Student-centered, active learning is one by-product of UCF's simulation course for faculty development called IDL6543. This six-week, mostly asynchronous course teaches faculty to learn to teach on-line. The course and its facilitators attempt to model the use of media, time and interaction to simulate an authentic learning environment for UCF faculty. On-line content and activities, group activities and the use of outside experts replace learning through lecture during class sessions. Asynchronous computer conferencing and synchronous chat are practiced in optional labs that engage learners actively. Noam (1995) states that true teaching and learning are about more than transmitting information. Education is based on mentoring, internalization, identification, role modeling, guidance, socialization, interaction and group activity. Using a combination of face-to-face and technology-mediated communication increases the formation of learning communities over using just face to face meetings or pure mediated systems (Etzioni & Etzioni, 1997).

Computer conferencing allows many more students (and faculty) the opportunity to reflect and participate in class discussions, socialize with classmates or ask questions on their time when it is convenient for them. Active, quality participation in on-line environments requires students to take more responsibility for their own learning and faculty to balance their role as facilitator and coach. Faculty need to balance roles as they retain their role of content expert and facilitate deeper learning by explaining, clarifying, directing and helping learners construct their own knowledge. UCF faculty taking IDL6543 experience the role of student in an on-line environment to better manage their role as an on-line teacher. The IDL6543 class has a waiting list of interested faculty on campus, and local educators from schools, community colleges and local military instructors.

Lessons Learned

Critical mass in developing web-based programs and services is achieved when the right combinations of faculty enthusiasm, technological infrastructure and administrative support lead to the recognition of pedagogical opportunities. Ideas breed, energies are focused, risks are managed and prior lessons are learned through facilitated learning communities among faculty and developers. Maintaining faculty cohorts promote the rapid adoption of pedagogical models, evaluation of Web-based tools and the creation of solutions. Conducting a formal faculty development class (IDL6543) is appropriate for those faculty committed or selected to create on-line courses, but informal brown bag lunches held regularly expand the development of learning communities among the mainstream faculty.

Facilitating the change in the shift in role as an on-line teacher leads to more student-centered, active learning. Faculty development programs that are collaborative and provide just in time learning prevent problems and increase satisfaction rates among faculty and eventually their students. Philip Repp (1996) describes learning that is student-centered versus instructor-centered teaching where: students discover knowledge, there is continuous student and course assessment, learning includes student-driven episodes that are observed by others (not only by the teacher), students help define the questions, students take proactive and active roles, learning is collaborative, competitive performance is valued, productivity is judged by student learning not faculty workload, faculty facilitate discovery and structure questions then coach students, and finally the focus is on the creation of learning environments versus typical classroom experiences (p. 53).

Learning technological skills is only part of the change process faculty must embrace to be successful on-line teachers. Faculty must find the balance of their role as facilitator and coach rather than pure subject matter expert and curriculum source. Students must engage in inquiry that goes beyond the walls of the classroom (McMahen and Dawsen 1995). At UCF, faculty teaching on-line remain active in faculty development by attending brown bag lunches and giving presentations as "web vets" to their peers. As of July 1998, approximately 130 faculty have been involved in on-line course delivery and the faculty development course, IDL6543.

Future Directions

In July 1997, a pilot study was launched to examine teaching and learning in the ALN environment in an effort to determine the impact of on-line courses on both faculty and students. This pilot study is focusing on five areas of investigation:

- Demographics of students who enroll in ALN courses;
- Perceptions of students who have enrolled in ALN courses;
- Perceptions of faculty toward the experience of teaching in an ALN setting;
- Assessing student outcomes in ALN and traditional environments; and
- Identifying best practice ALN courses on the UCF campus.

In the near future, the UCF Course Development unit will take on broader projects to design web-based software, systems and solutions to support both course delivery and service delivery for campus needs. UCF is a testbed for Educom's (www.educom.edu) Instructional Management System (IMS – www.ims.org) that is working on producing technical standards for web-based instructional use.

UCF will continue to experiment building on-line courses and services to support students and faculty and measure the effectiveness of learning outcomes and faculty and student satisfaction. Heterick and Twigg (1997) assert that network-delivered, computer-mediated learning experiences will dominate the post-secondary learning in the decades ahead. UCF lessons learned in designing learning environments for the 21st century will help it and others use information technology wisely to create educational opportunities and make its on- and off- campus community assessable anytime, anywhere.

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A support system to formulate care plans for senior citizens & dataInput methods for a Web database

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Abstract

The population of persons over the age of 65 is rapidly growing. In order to develop care plans for residents of long term care facilities and senior citizens in own home, Minimum Data Set Clients Assessment Protocols(MDS CAPs) and Minimum Data Set-Home Care Clients Assessment Protocols(MDS-HC CAPs) have been published by respectively HCFA(Health Care Financing Administration, USA) and interRAI(international Resident Assessment Instrument) Overview Committee as guidelines. According to provided guidelines, nursing staff spend much time to process measuring ADL(Activities Daily of Livings) of clients and to find problem areas of each client. We have developed the "Integrated Information System To Help Nursing Senior Citizens". This system has a few characteristics, that is, generating problem areas, providing shared files to nursing staff, simple MDS input methods and mobile handy terminal which includes video camera tool. Main aim of developing the system is to reduce paper works of nursing staff and to provide various information to nursing staff for smoothly carrying out their tasks. In this paper we focus data input methods to data base for MDS CAPs and MDS-HC.

1. Introduction

In order to provide methods of making care plan to nursing staff, two manuals have been published. One of them is for developing care plan of residents of long term care facilities, Minimum Data Set Residents Assessment Instruments Client Assessment Protocols(MDS RAI CAPs), the other is for senior citizen who stays in their own home, Minimum Data Set Home Care Assessment Clients Protocols (MDS-HC CAPs). [1] [2] Both methods are characterized as follows :

(1) Assessment : Taking stock of all observations, information and knowledge about a resident or client using MDS items.

(2) Decision making : Determining the severity, functional impact, and scope of a resident's problems, based on provided algorithm by manuals. This step is to find RAPs of each resident using proven MDS items(Assessment)

(3) Care Planning : Establishing a course of action that moves a resident or a client toward a specific goal utilizing individual.

(4) Implementation : Nursing staff carry out care plan.

(5) Evaluation : Reviewing care plan goals, interventions and implementation in term of achieved resident out comes and assessing the need to modify care.

These methods are very popular among nursing facilities. But till nursing staff reaches step (3), they have to deal with huge items for assessment and complex algorithm for determining RAPs The guidelines let nursing staff process much paper work. Furthermore in these processes, nursing staff has some issues, that is, errors in determining RAPs, processing time and so on. When nursing staff makes care plans, they cooperate medical doctors who have medical information of senior citizen to be cared for.

There are some research results in this discipline. Catherine's work is effectiveness of MDS to assessment that is, concerned with only step(1). [3] J. Derek's work focuses that how make care plan from proven MDS.[4] Others are as similar above mentioned works. The results does not contribute to reduce paper works of nursing staff.

We have developed the Web Aided Nursing The Senior Citizen Information System (WANTO) in order to help decision making and care planning to support medical information stored assessment to give social information. The system supports not only the nursing staff to reduce paper works but also provides various nursing, medical

and social information to nursing staff. Nursing staff can access this system via Internet or Intranet. Furthermore we have developed a prototype of mobile terminal as MDS input terminal which help to reducing time of input huge items into data base of WANTO.

In this paper, we mainly describe (1) the configuration and implementation of a software system which find RAPs of each client and keep the measured ADL data of each client and (2) how input the manual measured data to the data base.

2. System Design

2.1 Overview of System

WANTO that we have proposed is consisted of three parts as shown Fig.1.

Social Security Information System offers various information on social security system and welfare work which are in force by such the Ministry of Home Affairs in Japan to people to be cared and their family. When nursing staff or clinician are questioned by the elderly or their family, they get various information from database and give it to clients and their family. For example, receiving financial aid from government for buying equipment etc.

Medical information of WANTO is one of electrical patient log for cared old. This information system has various check up data, X-rayed film data, medical report of functional status caused by physical deterioration, brain etc, other related factors by medical doctor, taken medicine as a data base.

Support Nursing Information System is to handle MDS for finding problem areas based on proven MDS and to provide guideline for developing care plan to nursing staff.

Fig.1 Overview of WANTO

3. Implementaion

In this chapter, we mainly describe how realize Nursing Information System. This system consists of two parts, MDS CAPs and MDS-HC. WANTO has been implememted on LINUX, PostgreSQL.

3.1 Basic Structure

Nursing Information System consists of database keeping assessment of residents and clients and programs for handling assessment. A program finds out RAPs of each clien from stored assessment. The program is made with SQL commands. Nursing staff input assessment to data base. This system works as a Webdatabase.

This system has three input methods for inputing assessment to database. The first is to fill out online form, so using Web browser. The second is a specific mobile terminal. The system request only WebBrowser to client computers. Main softwares consists of generating problem areas program, data input program, update data program etc.

3.2 Data Input Methods

MDS CAPs has about 350 items and MDS-HC CAPs has some 200 items. It is not efficient for us to input such many value of items into database using filling out online form. This is not practical method. Input method should be inherited with traditional way, that is, paper media, what nursing staff is familiar with is a good way. Furthermore nursing staff wants to get specific equipment which has good human interface as similar as consumer electronics products. Thus We have developed three data input methods in order to improve these issues. We have developed three input methods as follows.

(1) Online form

On-line form enables users to fill out MDS proven data on Web browser.

(2) Fax relay to database

After filling out MDS data on the traditional paper forms, users send paper forms to Nursing Information System by fax. The system automatically converts image data into ASCII data and put data into database. Some programs to process these tasks have been developed with C language, image processing technology.

(3) Using optical card reader

We have redesigned paper media forms for filling out MDS. MDS questionnaires is printed on OCR paper

media form. After filling out blankets, nursing staff put the forms on OCR equipment then press start button. The software automatically reads forms and stores the data to database.

3.3 Care Support Terminal(CAT)

CAT has been designed as personal handy terminal which can accept MDS forms, convert image data into text data and transfer them to Nursing Information System via Internet. CAT consists of handheld computer, handy image scanner and modem. Attach case is enough to hold CAT. The computer programs which are in CAT are developed as like as using fax relay to database. CAT also provides TV conference system to nursing staff.

4. Practical Usage

4.1 User Interface

Fig.2 shows a example of window for marking each MDS item. Users have to type only some items on screen, patient's ID, name(given, family), etc. See Fig.3. After typing these initial items via computer scree(Webbrowser), we are able to use paper media on printed above mentioned some items. These items are easily converted to text data for transfering them to data abse using image processing software. After inputting proven MDS with one way, users may execute program which finds problems areas by clicking button. Results of processing is shown on the WebBrowser. See Fig.4 Users can get each guideline of each problem areas with clicking each most left cell. This is so help manual for care plan development.

Fig.2 An example of marking MDS

Fig.3 Text Input Window, MDS-HC

Fig. 4 An example of found problem area, MDS-HC

Fig. 5 Red colored sentence shows triggered MDS item

Fig.6 Help Manual for developing care plan

4.2 Home Care

Nursing staff visits patient's home with mobile computer and portable handy image scanner. In assessment, nursing staff interviews client or his/her family and fills out the forms. The forms are scanned by image scanner. Scaned data is converted to ascii data and be transfered to Nurising Information System. All these tasks to nursing staff could be darryed out by CAT.

Problem areas are generated by program in Webdatabase's procedures after transmitting. And found problem areas are shown to client and family. As the occasion demands.

If nursing staff finds some medical problems of client, nursing staff contacts medical doctor using CAT TV conference function. Furthermore as nursing staff follows doctor's instruction, nursing staff send blood pressure taken, pulse count, photograph or video to doctor. Medical doctor diagnoses medical problems of clients based upon transferred data. And medical doctor give some instruction to nursing staff.

Nursing staff can collaborate with medical doctor using CAT and WANTO.

4.3 Nursing Home

COPY AS RECEIVED BY ERIC

When clients stays in long term care facility, staff measures MDS from each resident's ADL. Nursing staff fills out forms. Nursing staff input proven MDS into Nursing Information System of WANTO through scanned imaged MDS forms. Program in the system converts image data into text data for storing them into database. The System generates problem areas with input MDS. Furthermore medical doctor input X-rayed film data, various check up medical data or medicine to expenses into Medical Information System of WANTO. Facility staff, nursing staff, medical doctor, dietitian or care worker have meeting to make care plan based on MDS, problem areas and medical information. Such meeting is periodically hold. For supporting the meeting, relation between past proven MDS, care plan and current MDS is analyzed by WANTO.

4.4 Evaluation

Practical examinations has cleared that this system reduce nursing staff spending time to find problem areas of each client based on MDS. For example traditional way which means manual let nursing staff spend more than fifteen minutes to find out problem areas of each client. This software system need less than a few seconds for finding problem areas.

Data input methods that we have developed enables us to easily input data into database. Although we have to spend some twenty minutes for inputting same number of MDS data using filling out online form. Results of practical examinations in data input methods shows less than one minute for 200 items of MDS-CAPs, 300 items of MDS-HC.

5. Conclusion

We describe new methods to input answers to questionnaire into database. This way reduce the time of inputting data comparative with filling out online form. Although these methods initially have developed for supporting nursing staff, but we believe this methods could be applied to another topics.

WANTO that we have proposed provides "Care On Demand" to nursing staff. Thus the team which consists of nurse, social worker, dietitian, medical doctor can share all data/information of each residents/clients, ADL, MDS, problem areas, care plan etc. At last this system can provide high quality care to clients or residents.

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EDUCATION, COMMERCE, AND COMMUNICATIONS: THE ERA OF COMPETITION

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Abstract: Consequences of the coming world wide competition in courses, degree programs, and training and what it may mean for higher education in the future are discussed. Traditionally, institutions of higher education had some security in what amounted to geographical monopolies corresponding to the physical campus location. The consumer is now becoming free from that constraint. This will probably mean the emergence of virtual organizations and serious survival concerns for those institutions and associated faculty that cannot adapt or compete in the new environment.

Where is the wisdom we lost in knowledge?
Where is the knowledge we lost in information?
T. S. Eliot (The Rock)

INTRODUCTION

A decade ago the practice of remote education was largely limited to inexpensive asynchronous correspondence type courses using surface mail, or very expensive video broadcast systems with audio feedback. Typically remote education embodied a very narrow concept of communications between a single instructor and a single student (correspondence model) or the broadcast of material to a largely passive large audience (broadcast model). The latter was claimed to be an attempt to replicate the atmosphere of the face to face class. Both forms proved to be a sad second in quality and performance relative to the small interactive face to face class. Today, many people still consider remote education a poor second (thought necessary for some) to on campus education because of those earlier experiences.

Those of us who have worked with remote delivery of courses, using group communications and the Web, have found that remote students can do at least as well as on campus students, and in some cases better [Hiltz 1994]. Even campus based face to face classes can be a lot better when they utilize appropriate group communications technology [Turoff & Hiltz 1995]. There is enough evidence from experiments and field trials to consider the above a scientific finding [Hiltz & Wellman 1997]. In my own case, distance students are part of the same asynchronous on line conference that includes my face to face students. The only difference between the two is that remote students get video tapes of my lectures. When we first started to employ group communications in the early eighties, we were using computer conferencing for face to face to face classes, NOT distance learning [Hiltz and Turoff 1993]. While we believed it made a major improvement to regular courses, it was only distance learning that held the interest of those who had money to sponsor studies of the use of the technology in the educational process.

What is important to realize is that it is not only technology that is important but the learning methodologies utilized to employ the technology. Asynchronous group communication allows the use of collaborative modes of education where students may work on team oriented assignments. They may communicate and work together as small project teams. It is this key difference that makes most of the quality improvements possible. Furthermore, students can see the quality of each other's work and this seems to be significantly more motivation for good work than when just the instructor sees the students work. These impacts occur for regular students as well as distance students [Turoff 1995].

The paradox of automation is that when one takes what is done manually and uses computers to imitate the same process, the loss is the opportunity to carry out the objective in new and innovative ways that can enhance the quality of what is done. This lesson keeps repeating it self in new application areas. Successful use of the technology involves Virtual Classes that are very different than the face to face class.

However, another truism in the field of information systems is that innovative use of the technology often gets derailed when it is implemented on a mass scale. We saw this in the early years of most IS innovations. What gets marketed to the masses was not always representative of the systems that demonstrated the innovation. For remote education this is even a more extreme a problem because there is a social revolution as well as a technology revolution taking place.

At the same time that the technology allows the offering of remote education it also completely eliminates the safe geographical monopolies that many institutions of higher education could count on as a core market to maintain their stability.

Any college or university can now offer their courses and degrees at a reasonable cost anywhere in the world.

We have entered the era of world wide competition among institutions of higher education. (In the long run this will also apply to public and private education at all levels and various student services, such as tutoring.)

THE ERA OF COMPETITION

For a mere $15 million (less than the cost of a single college building) one could start a virtual university serving two to four thousand students where each instructor gets $150,000 a year to work with student classes in the 25 to 50 size range. Tuition at such an institution could range from $7,500 to $15,000 a year [Turoff 1995]. Even an existing university can do this if it can ignore the current sunk costs of maintaining its physical campus when doing remote education. Even if one does not agree with the academic design presented in this earlier paper, one has to realize that the analysis means that there is little economic barrier to any institution getting into the field or for new institutions to start up.

The growing cost of higher education tuition is creating an economic umbrella under which new institutions and new programs can prosper. The economics are even more dramatic if one goes to the correspondence course model:

- One academic doing the video tapes or on line multimedia course material with video clips, voice clips and CAI type aids that can "teach" (in broadcast mode) thousands of students.
- One teaching assistant or hired grader can grade problems and exams for 100 students at a cost of about $5,000-10,000, or an AI system that can do the grading when we restrict the questions to "well structured" ones.
- Communication limited largely to email between the individual grader and the student.

While I think many of us who are academics cringe at this model of education, I am afraid that pressures of cost reduction are forcing many administrators to take this model seriously. The students enrolled in the correspondence course form of learning may never know what they are missing. For those who are working part time or full time, have family or work commitments, this form of education is a Godsend. It allows them to choose when they will participate, eliminates travel time, allows them to use late night hours, solves course conflict problems and puts the scheduling of their time entirely under their control.

There is considerable effort underway to utilize group communications and collaborative learning methodologies (See: Society for Asynchronous Learning Networks http://www.aln.org). However, I suspect the vast majority of distance offerings by universities, colleges, and corporate training operations throughout the country is still following the "correspondence course" model with a focus on email and web delivery of multimedia material.

Even in the ALN community there is a lack of perception among many institutions as to what is really taking place. At many institutions of higher learning the distance education mission was, and still is, treated as a separate education entity and in some cases not under the direct control of faculty or departments. At NJIT, on the other hand, over half of the enrollments in distance education are from regular on campus students seeking to eliminate course scheduling conflicts and be able to complete their degrees earlier [Turoff 1997].

> The normative goal of the use of the Web and group communications for educational delivery should be to completely eliminate the need for any distinction, organizationally or functionally, between distance students and on campus students.

If the same technology is applied for all courses, then the individual students may choose whether to attend lectures, view video material, and/or utilize web multimedia material. There is then no need to distinguish in any way shape or form between distance students and face to face students. Many students who attend my face to face classes go to the library to view videos when they have to travel or when they feel the need to review lectures before an exam. Many foreign students with language difficulties want to be able to hear some lectures more than once.

We can contrast this view with what a number of current programs are engaging in which is "skimming the cream." Duke University, for example, has introduced a remotely offered MBA. The on campus students normally pay tuition in the range of $40,000, but the distance student will pay over $80,000 for the same degree program. In the past the most lucrative distance programs were those where industry picked up the costs for the student and targeting industry sponsors is one of the current marketing philosophies in use.

One view of the marketplace by some educators is the largely industry market providing "just-in-time," on demand approach to electronic educational products offered by virtual universities through intermediaries called "educational brokers" [Hamalainen et al. 1996]. The concept of "just in time education" points to the lack of understanding among many educators as to the necessity to understand first what market higher education serves. Traditionally, we have been there to serve the students by providing a degree program that will allow them to change their lives and their jobs. Industry on the other hand wants education that is just enough to improve their performance on current jobs and is not interested in losing their employees. For example, many companies supporting tuition do so on a course by course basis and will not support courses not considered relevant to the current job of an employee. Subjects such as philosophy is not often considered job related! Yet I would claim that those students with a strong background in philosophy make better information system designers. When one gets into discussions with some industry representatives it is clear, for example, they want things like specific language courses and not general language theory courses that will allow students to pick up most new languages on their own.

> It is not clear that serving what industry wants is always consistent with the goal of an institution of higher education to serve the student. Who is the customer is a fundamental question!

Unfortunately students sometimes do not appreciate the value of some the things you try to teach them until long after they have completed their education. On the other hand, I have found by mixing my face to face students with the remote students that often the remote students who have been out in industry for many years are a considerable aid in letting the other students know the value of some of what they are learning.

BROKERS & MARKETEERS

Another aspect of the emerging marketplace is the "brokers" who can translate into an additional bureaucratic layer between the student and the educational process. If the prospective student were an intelligent consumer with all the necessary information to make a wise market choice, brokers would be unnecessary. Sooner or later the students and companies will learn that most of these have specific products they are marketing and they don't really serve as an unbiased broker. A counter trend is the growing number of publications reviewing and rating colleges and attempting to provide consumer information. Every year they seem to be getting a little better at this but nowhere near what is needed. The education decision for the consumer is a decision equivalent in cost to buying a new car every year. We can expect to see a "consumer report" organization on higher education that might also become the "amazon" of course providers. It would charge the consumer directly for finding the right match of a degree program or combination of courses. Such an organization would not work for any regional or other set of universities or providers.

The power of intelligent consumer feedback on courses, degree programs, and institutions, gathered on the web and provided for the consumer, will be a major factor in the evolution of a truly free enterprise marketplace in learning [Turoff 1985, 1995]. Just as Amazon.com is doing with books, some future retailer will market consumer evaluated educational and learning options.

ACCREDITATION

This brings us to another key element in the puzzle of trying to understand the future of this area: accreditation. Right now only degree programs are accredited. Consumers at the undergraduate level seem to have little understanding today of what accreditation actually is. To some extent remote programs have been ignored or only superficially examined by most accreditation reviews. As a result a lot of remote courses can be taught by adjuncts, sometimes a much higher portion than would be acceptable for the normal program. However, one gets the impression that accreditation organizations and associated professional societies are waking up to the need to look more carefully at these programs. There are a number of significant changes that the consumer is going come to understand and want.

> A student taking courses from separate educational institutions, which are still part of the same accredited degree program at the different institutions, should have no problem in knowing the course will count for that degree regardless of the institution it was taken at.

This is the sort of policy a single educational institution can adopt and as a result we expect to see such policies become commonplace. As an expected long term consequence, students will be able to sample institutions without penalty or find their way around the problems of closed out courses at their own institution. Our own studies have shown part time working students in Computer Science at NJIT can take a decade or more to get a degree. With the addition of remote courses they can often cut three or more years off this time frame [Turoff 1998]. The sequence of prerequisites in many technical fields means that the loss of the opportunity to take a course in a given semester has more than a linear impact on the time required to complete the program.

Another and even more desirable change would be the accreditation of faculty on an individual basis that would go with the faculty member if he or she changed institutions. I won't hold my breath for the latter but the former will come ultimately as a result of consumer pressure.

With universities, colleges, commercial companies and various consortiums (around the world) all putting courses on the Web, this area is going to suffer the problem that from a quality standpoint a significant number of offerings are going to be almost fraudulent in terms of the quality of offering. There are already a number of diploma mills on the Web that are milking consumers and which undermine the integrity of higher education in the consumers' eyes. The accreditation agencies, in the long run, are there to serve the consumers, or should be. Unless they wake up to their responsibilities in this area the result could be that higher education will lose further respect and support of the political body. The public role of accreditation agencies can be replaced by further "magazine surveys" and new organizations serving the consumer. Accreditation groups should form a consortium to provide the consumer an international clearing house of detailed accreditation information available through the Web.

There are already US, English, Australian, and other European institutions marketing courses on an international basis. Given the large numbers of students not able to afford to go to another country, we can expect a significant rise in remote international students.

TWO APPROACHES

One way of trying to understand the future is extrapolating current trends to their extreme and developing two contrasting scenarios to represent the future of distance education. This is quite easy to do in this case by merely contrasting choices based upon minimizing costs verses maximizing quality.

Characteristic	**Maximum Efficiency**	**Maximum Effectiveness**
Learning methodology	individual study and practice	collaborative learning oriented small groups
Instructors role	creator/presenter of "canned" reusable material (instructor may be virtual)	facilitator of groups exploring knowledge and a consultant on reaching understandings
Class sizes	thousands	ten to one hundred (with appropriate software)
Staff	graders and/or problem consultants.	Little or none, small group interactions
Objective	acquiring skills (e.g. how to do a derivative) and training	acquiring cognitive processes (application domain oriented problem solving), e.g. being able to conceptualize a derivative appropriate to investigating a physical problem
Similar current models	large mass lecture classes, TA problem solving groups	small graduate seminars
Social Outcomes	small number of totally virtual universities buying and reselling courses as needed	able to run courses appealing to only very limited numbers but having world wide student access
Control	largely organizational and market driven	faculty driven
Technology	Email, multimedia WEB documents, CAI software	group communications, collaborative Hypermedia knowledge bases and animation type recordings of thought processes.

As one reflects about the above breakdown it should be obvious that there is nothing wrong with having inexpensive ways to deliver skill training. However, for a good university the amount of skills taught as a part of any course should largely occur in the lower division years. What faculty really should be teaching students is how to do problem solving in their subject domain. To do this successfully requires a high degree of communication between the faculty and students so one can perceive if the learning process is successful and adjust it accordingly. To become an expert or "master" in a given field the student and the class need the intelligent guidance and insight that only an accomplished professional can provide.

SUPPORTING FUNCTIONALITY

There is a lot to be said for the old fashioned blackboard in that it allowed the instructor to illustrate a problem solving thought process by the animation of that process. As yet none of the easy to use word processors allow an instructor to create even the simple animation of the derivation of a formula or concept. One does not learn how to paint by looking at a finished paining; one has to view the creation of the painting.

In our Virtual Classroom™ software we have the simple facility that if the instructor posses a class discussion question, no student can see the answers until they have supplied their answer. This simple control on the group communication processes makes the concept of the discussion question a better educational method when done through the computer rather than face to face [Turoff & Hiltz 1995a]. Probably a majority of faculty today considers that education over the Web will always be a poor second to the physical classroom approach. Such a person asked to teach with the Web will probably carry out a self full filling prophecy. One should be willing to face the challenge of making it better experience. It is our belief that the Virtual Classroom type of technology employed with collaborative learning methodology can be a more effective educational environment than the physical classroom.

One basic limitation on the current generation of commercial group communication system is the inability of the instructor to impose semantic oriented Hypertext discussion structures that reflect the problem domain of the course structures [Turoff et. al. 1997, 1999]. With such an ability the resulting discussion can become largely self organizing and allow us to have classes with 50 to 100 students. Based upon our experience in using this technology in the collaborative learning mode I would estimate that each 10 students who are active in a course will generate between 300 and 500 comments in the class conference in a typical semester. This is a function of the subject matter and the behavior of the instructor as facilitator. This does not include their private small team conferences. Right now more than 50 active students will lead to information overload [Hiltz & Turoff 1985] when using a collaborative learning approach. The current generation of available asynchronous group communication technology is largely restricted to simple comment-reply association structures for representing the discussion. Unless a single person exercises the authority to move comments around and carefully index them with the correct key words, the transcript for complex discussions becomes increasingly disorganized [Turoff, 1990, 1999]. Hierarchical indexing schemes require a highly trained indexer to remain consistent and useful.

It is important that the instructor can easily structure and facilitate the activities and assignments taking place in the conference. We provide a tracking table for each student that shows a student whether or not he or she has completed that assignment. It also allows the instructor to keep track of which students are falling behind. Students who don't keep up begin to fall into a situation where catching up is to daunting and can lead to information overload on an individual basis.

Simple facilities like a grade book (shared spread sheet with special access controls) make a big difference in reducing the amount of email that would otherwise have to flow. Also, the ability of the members of the conference able to see who has read to what point in the discussion means the instructor can tell whether a student is up to date, and the members of a team can tell who is not keeping up and contributing. In a successful class in this environment it seems to be the rule that 10-30% of the communications are generated by the instructor. This means the instructor spends more time communicating than any individual student. Any facilities that minimize the effort to track and monitor what is taking place are a highly productive contribution to the functionality of the system. This is also another reason why a successful course is an effort for the instructor that is leaner in size with the number of students in the course.

The future will revolve about collaborative subject domain oriented multimedia knowledge basis. Students in many related courses will be contributing reflections and new materials and the instructors will facilitate and guide these activities. A single knowledge base based upon non linear semantic associations and relationships of

material may represent a whole set of courses with a degree program. Lectures will gradually become small (5 to 20 minutes) segments of video and voice clips associated with semantically linked hypertext/hypermedia oriented material. The instructor will be responsible for synthesizing and lowering the entropy level of the accumulated material in his or her area of the knowledge base.

The very concept of a class might dramatically change. As one example, consider a business curriculum where the beginning freshman student enters as a low level employee in a simulated virtual company and as a senior they exit as top management.. The faculty act as consultants to various individuals, offices, and divisions of the company. If the company needs to develop a computer based application than the task transfers to a development populated by students in IS and CS courses. Clearly one can extend such a model to a whole set of enterprises that would cover most the disciplines that prepare students for their roles in the society. An effective collaboration technique is letting students try to learn enough to act as instructors to lower level students. Instead of a student or student team just doing a report on some topic, they also have to present it to the rest of the class. As yet there have been little in the way of software to specifically support some of these possibilities or to integrate materials and the learning process across sets of courses. This is a largely unexplored area.

There is a great deal of software still missing for instructors and students alike [Turoff & Hiltz 1995]. Educational institutions should try to insure that they can remain flexible and be able to switch to better systems as they are made available. What is currently on the market is only like the crude beginnings relative to what is possible and what has been demonstrated in the research environment. The key functional issue is whether the system forces all professors into the same framework or allows individual faculty to creatively work from a very general and flexible toolkit. Such a kit would allow the sort of individual course tailoring consistent with differences in subject areas and individual instructor styles. Approaches that try to make all courses look alike and have all instructors follow the same plot are doomed to stifle the creativity that will continue to evolve this area. It will create further resistance by the very academics that are key to its further advancement.

The next evolution of Virtual reality will allow students to tailor genes to produce organisms and watch them grow and interact in a virtual world of organisms, rather then modeling an image of the finished organism. While medical students will be able to investigate electronic cadavers (or simulated live humans), imagine some of the impacts in the training fields where pragmatic knowledge is not found or mastered alone from text books. A group of apprentices learning to be carpenters, plumbers, electricians, masons, etc. can work as a group in a Virtual World to build a house from the basic raw materials and tools found in the real world. Just as medical students can never get enough physical cadavers to experience a wide range of different medical conditions, the craft's apprentice cannot usually experience a similar wide range of building challenges. There is one demonstration system already where individual dance students can put their dance composition into a virtual space to view individual or group compositions among remote dance students. The virtual lab for group efforts is still a challenge that creative faculty need to be encouraged to pursue.

THE LIKELY FUTURE

Perhaps the problem that too many institutions of higher education (and perhaps faculty as well) have is that they have come to think that teaching skills is their objective.

The one irrefutable fact about the technologies of personal computers and educational software is that skill training can be largely automated and that commercial organizations will be able to deliver such canned software at prices universities and colleges cannot compete with.

> Institutions of higher education should become clearing houses for good skill and training material but will have to eliminate courses that are almost totally based upon such material.

There is a small number (probably less than 100) of basic "101" courses that are taught at most institutions of higher education. A major objective for commercial ventures will be to create canned versions of these courses that will allow most students to prove competency, based upon exams. As a result, the ultimate long term success of institutions of higher learning will be based upon market differentiation. In some sense higher education is going to move full circle back to the roots of the middle ages where instructors were the facilitators of seminar groups of students who worked together to master a subject. However, the seminar will be conducted largely through the Web and small will be more like up to 100.

There is little doubt there will be a tremendous shakeout in higher education in the next decade as a result of competition. Colleges and universities need to rethink their objectives and reexamine what is the product they are offering, and to whom. Given the investment consumers make in higher education, they will become a lot more intelligent about their choices.

In the definition of a Virtual Organization put forward by Mowshowitz [1997], the VO becomes a communication switching system able to dynamically allocate a specific request for a service or product to the best provider or satisficer from a long list of alternatives. One has to realize that higher education is ideally suited to operating under the VO model provided one believes in the complete modularization of course materials, the just in time learning concept, and the idea that all faculty teaching a given subject teach essentially the same thing. There are now canned courses for learning languages like C available from commercial companies that are significantly cheaper than a typical college course at most public institutions.

The "amazon.com" of higher education will offer the student a mix of educational modules from packaged self instruction software to remote course alternatives at different institutions. Those whose primary interest is in obtaining a skill level for a job in industry at an inexpensive price will find that very appealing. Given the current atmosphere in corporations, outsourcing the corporate training to such a provider will also be very attractive. What is doubly important about the "amazon" model is the ability of readers to add their review of the product to the original advertisement [Turoff 1985]. This type of consumer informed marketplace is what will speed the process of change. Along with this marketplace could also be something akin to what has happened to the airline industry, where for courses with real instructors you can pay a high premium to get early registration. Later, when it is clear that there are unfilled "seats," the costs drop and bids are accepted. The reputation of the pilot (instructor) would also influence the cost of a seat in the class.

> What ever mechanisms and fee structures evolve the key change will be consumer awareness of the relative quality of course material and/or instructors across alternative institutions or sources.

Students will have a great deal more flexibility to pick and choose by their own criteria. Foreign students will not need to travel to the U.S. to get a U.S. degree. Neither will U.S. students be limited to U.S. based degree programs. Many examples are already underway of students taking courses across international boundaries. Remote management degrees have been available in the US from England for some years. There are a growing number of people working, retired, or homebound, who are just interested in learning for enjoyment and this will be a booming market. Russian literature might be more interesting from a professor in Russia than from a local community college.

FACULTY

Faculty are still the key to the future but it is uncertain whether they will destroy themselves or evolve into something new. The battle of material ownership is a key issue faculty will not compromise on; however, if they refuse to evolve their teaching methods and adapt new learning approaches they will be condemning their institutions and the future role of faculty in the educational process. Too many institutions seem to feel the material is more valuable than the faculty person who created it. For many academic fields the productive life time of the faculty member is much longer than the lifetime of the material they create.

In the sort of educational marketplace that will evolve capable faculty will be the critical element in creating quality programs that become recognized. The technology, if designed and utilized correctly [Turoff & Hiltz 1995] can give the faculty member a great deal of control over materials and power to rapidly evolve the materials. In fact a well run collaborative oriented learning course has the students aiding the professor in keeping up to date in the literature and evolving better materials for the course. However, many faculty still reject the notion of changing the "sage on the stage" educational process they are used to. Even worse, some prefer the correspondence course model and would rather delegate direct two way communications with the students to intermediaries.

Regardless of what is written down, the rewards for faculty are far more tied up with research and external funding and the educational side merely has to be acceptable. Innovation in education and exceptional teaching have little relative impact for young faculty at many institutions. This is clearly a problem with administrations. While they are focusing their attention on competing in research and obtaining sponsored funds, the nature of the educational process is undergoing a fundamental change that is not really understood or anticipated. There are going to be some very rude awakenings in the next decade. Because of the time needed to change peoples' attitudes and bureaucratic processes, some of these awakenings may occur too late.

> Competition in education on an international and national basis will become the principle determinant of the success or failure of institutions in the next decade.

The underlying factor of success in the future will be the talent of the instructors and their commitment to excellence in learning. Institutions may well have to reassess the relative balance in faculty rewards between teaching and research.

CONCLUDING REMARKS

Students and faculty both are in for a very interesting decade of change. There was no intention to say that the technology that makes the written word the primary

communication mechanism for learning will satisfy everyone. Our own evaluation efforts show that about 20% of the students that take a course this way still prefer face-to-face classes even when they have been part of a fairly successful class. There will always be population of learners that will prefer face to face discussion groups and will be willing to pay extra for that privilege in terms of travel, time, and effort. However, face to face discussion classes can still use this technology to greatly improve those face to face discussions. Voting processes and other tools can be used to help discover quickly what aspects of topic need more in depth discussion by the class [Turoff & Hiltz 1995b]. The quality of face to face meetings can be greatly improved through the adjunct use of Computer Mediated Communications [Hiltz & Turoff 1993].

The key to the future in my own view is the incorporation of the technology for group communications into regular classes and the movement of all university student services on to the networks. There is no reason why any function the university provides the student cannot be handled via web based communications (well maybe not the gym). Even the most demanding of applications which is synchronous tutoring could be handled with a shared electronic blackboards with integrated digital voice. Internet II is not that far away and the only limit becomes the bandwidth into the learners home. The future is the Virtual University.

Forget remote education, the technology of group communications and collaborative learning methodology can significantly improve regular courses at colleges and universities. When this occurs there no longer has to be any real distinction that has to be made between regular students and distance students. All students should be treated as one in the same by institutions of higher education. The goal for distance education as an institution should be to eliminate itself. To a large extent the individual student should have the choice of the mix of media they wish to use for any individual class. As for faculty, there are a lot of us who believe in this form of instruction and it is our academic right on individual bases to make this choice. Faculty bodies that want to prevent this transition from occurring are as bad as administrations that want to limit faculty control over their classrooms and their education materials -- whether physical or electronic. In the long run the evolving marketplace in higher education will make some of the current debates seem almost comical. Colleges will not get away with academic courses for a thousand students and those faculty and programs that stay with the past will gradually loose their market (beginning with the best and brightest students!).

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An Elaboration Likelihood Approach to Understanding Response Rates in Web-Based Surveys: A Proposal

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While the World Wide Web (WWW) is being used more and more frequently as a survey administration and data collection tool, little research has been conducted towards improving the WWW as a valid method for survey research. Accepted practices in the use of mail, telephone, and face to face interviews have evolved from years of experience and research investigating the most efficient and effective practices. The use of the WWW for survey research certainly lends itself to efficiency, but the effectiveness of various practices are yet to be determined. A common practice in attracting individuals to a website is the use of a banner ad. When a target web page contains a survey, the banner ad is akin to the cover letter in mail surveys. This papers seeks to investigate factors which may influence and explain how and why individuals choose to respond to banner ads for web-based surveys. The Elaboration Likelihood Model (Petty & Cacioppo 1986) is used as a theoretical basis for understanding the effects of different cues (present in banner ads) on a receiver.

The Elaboration Likelihood Model

The Elaboration Likelihood Model (Petty & Cacioppo 1986) suggests that there are two routes to persuasion: the central path and the peripheral path. An individual who is unable (due to distractions) or unwilling (not motivated) to think carefully about information in a message will be more influenced by simple, also called peripheral, cues in a message, while an individual who is able and motivated to think carefully about information in a message will be more influenced by message content, or central cues. Peripheral cues might include repetition of an argument, an attractive or celebrity source of a message, the number of arguments presented, pleasant sounds, colors, rewards, images, and pictures. In contrast, central cues include the quality of the message itself. Further, while a variety of factors may affect whether a person processes a communication with higher or lower levels of involvement, the need for cognition (Cacioppo & Petty 1982) describes a stable individual preference for either central or peripheral processing of information.

The Need for Cognition

In the ELM, the need for cognition represents a motivation factor in thinking about communication. Individuals with a low need for cognition are thought to have low intrinsic motivation to engage in effortful cognitive activity and, therefore, prefer peripheral cues over central cues in information processing.

Individuals with a high need for cognition possess high intrinsic motivation to exercise and enjoy effortful cognitive activity. Thus, individuals with a high need for cognition tend to prefer the central cues and a higher level of involvement. In applying the ELM and need for cognition to decision making processes present when an individual sees a banner ad for a web-based survey, the model suggests that individuals with a low need for cognition will be more likely to respond to banner ads with central cues.

An Overview of Methods

Banners for the study have been developed and designed to include a peripheral cue and a central cue. Peripheral cues are operationalized with the message, "opportunity to win valuable prizes" on the banner ad. Central cues are operationalized with the message, "opportunity to contribute to an important study." The need for cognition will be measured using the Need for Cognition scale (short form) developed by Cacioppo, Petty, and Kao (1984). In addition, several demographic questions will be asked in order to describe the sample and investigate possible differences in demographic groups. In order to better understand the characteristics of the sample, and to look for correlations between use of the WWW and need for cognition, several questions on web use are included.

The banners and questionnaire have been pre-tested using a panel at ZUMA - the Center for Survey Research and Methodology in Mannheim, Germany. Following the pre-test, banner ads will be placed on Yahoo.com and on Fireball.de. The banner ads will be randomly rotated by the search engine and linked to a target site which contains the questionnaire. The page views on both search engines will run for one month with 20,000 page views on Fireball.de and 75,000 page views on Yahoo.com.

Significance of the Study

From an applied approach, these results could be used to improve the efficiency and effectiveness of web-based surveys. Currently, many banner ads offer financial incentives and prize opportunities in exchange for the participation of a respondent. The need to offer such financial incentives makes conducting research via the WWW economically challenging. If such incentives were not critical in attracting respondents, research could be conducted while incurring less expense. From a theoretical perspective, this study offers an opportunity to better understand communication processes on the WWW, to evaluate the applicability of current models of persuasion to this growing medium, and to explain how individual differences in personality and perception may manifest themselves in web-based communication.

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Using Web-Based Course Materials as a Change Agent: Creating a Technology Community Through Diffusion of Innovation Theory

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1. Introduction

This paper describes how Web-based course materials are being used as a change agent to foster the adoption of instructional technology innovation at the University of Minnesota, College of Education and Human Development (CEHD). Initial efforts to introduce instructional technology into the CEHD environment centered on the development of a template model designed to support faculty with the transition of traditional course materials to delivery via the Internet. Several faculty have asked the Web Development Team to put their courses up on the Internet and a few have made use of the course templates themselves. Efforts to date have resulted in fewer than 20 courses (out of a possible 1800 during the regular year) with a Web presence. To better understand the reasons behind this very limited response, the Web Development Team turned to diffusion of innovation theory for insight. Current CEHD Web development efforts seek to use diffusion of innovation theory to expedite the adoption of a new Web course creation tool and to create a technology community within the college.

2. Background

In the fall of 1996, the CEHD administration charged an internal Web development team with designing and maintaining a standardized World Wide Web presence for the college (representing communications, student services, and instructional uses of the Web). This resulted in increased interest from college faculty to offer instructional materials via the Internet. In an attempt to balance the needs of the faculty and the Web Development Team, a series of templates were created that allowed faculty to "cut and paste" their content into pre-existing Web pages. The model drew heavily on constructivist learning theories, cognitive psychology principles, as well as user-centered design (Duffy & Cunningham, 1996) (Winn & Snyder, 1996) (Norman, 1988). Despite available software training, graphic design assistance and unlimited access to the CEHD Web Development Team, few instructors placed courses on the Internet.

A recent partnership with the College of Liberal Arts (CLA) has given CEHD access to a well designed, user-friendly Web course creation tool called ClassWeb. By evaluating the previous course development model against diffusion theory, the Web Development Team hopes to identify the weakness of the current model and formulate a strategic plan designed to facilitate the acceptance of ClassWeb by CEHD faculty.

3. Diffusion of Innovation

Diffusion of innovation theory addresses the process(es) used to communicate or introduce innovation into a social system over time. Successful diffusion efforts recognize and work within the composition, culture, customs, and climate of a given population. The Web Development Team hopes to leverage the five characteristics of innovations when introducing ClassWeb to CEHD faculty.

3.1 Characteristics of Innovations

Relative advantage "is the degree to which an innovation is perceived as better than the idea that supercedes it" (Rogers, 1995). In short, do CEHD faculty members perceive the ClassWeb course creation tool as a significant improvement over the current template-based system? As ClassWeb is a custom designed tool that specifically addresses the needs of CEHD and CLA faculty, the tool is free of extraneous information that might confuse a new user or hinder the development of course materials.

An innovation is perceived as *compatible* if it is seen as consistent with "existing values, past experiences, and needs of potential adopters" (Rogers, 1995). Are the innovations advocated by the development team consistent with this description? ClassWeb is accessed via any standard Internet browser, thus removing the need to learn complicated software. As most CEHD faculty are regular users of the Internet, ClassWeb is felt to be highly compatible with the needs of the faculty.

Complexity refers to the perceived difficulty of an innovation. Less complex innovations tend to be more readily adopted. From the viewpoint of the CEHD faculty, how complex does the current model appear? Perhaps the single biggest impediment to adoption of the current system has been the perception of complexity and the resulting demands on faculty time to use the model in a meaningful fashion. ClassWeb is a very simple tool to use, and the resulting decline in perceptions of complexity should greatly facilitate its adoption in CEHD.

An innovation exhibits *trialablity* if group members feel it can be experimented with on a limited basis. Trialability creates a safety net for most adopter categories, making them more comfortable with an innovation before committing to whole adoption. As there is no central mandate to put courses on the Web, faculty are free to experiment with the product as much as they want. In addition, ClassWeb is a scalable product that can create more sophisticated sites as the users level of sophistication grows. Faculty will also be able to access ClassWeb from off campus, providing the additional comfort level of being able to work on their own computer.

Observability "is the degree to which the results of an innovation are visible to others" (Rogers, 1995). The current model depends on faculty to drive the creation of course Web sites. ClassWeb was funded and created through a student-led initiative and students in CLA expect that their courses will be represented in the system, offering a high level of visibility for the system. The Web Development Team hopes to use this observability with both faculty and students to drive additional use of the tool.

3.2 Adopter Categories

In an effort to better understand the current CEHD climate, the Web development team first needed to recognize and identify key people in the following five adopter categories:

Based on a normal distribution, *innovators* comprise the first 2.5% of a population. They are, as a group, "venturesome", control considerable resources, and are able to rather easily understand and apply technology (Rogers, 1995). True to the profile, CEHD innovators tend to have more peer contact outside of the local community, and are not readily understood or appreciated by other CEHD members. As other groups begin to embrace technology more readily, the innovators, both faculty and staff, have begun exhibiting behavior aimed at maintaining their "outsider" status.

Early adopters command the next 13.5% of the normal distribution. Again, following the diffusion model, the CEHD early adopters tend to be well-respected members of the college community. Their willingness to try new things, as well as their vocal support of the development team, have helped to influence members of the later groups. This group currently makes up the bulk of our clientele and will compose the initial group targeted for instruction on using ClassWeb.

Early majority group members are the next 34% of the population. According to Rogers, they "may deliberate for some time before completely adopting a new idea" (Rogers, 1995). In CEHD, this population is often found consulting with the development team, but have not produced or initiated any projects to date. This is the audience segment from which we must solicit greater participation. By involving a greater portion of the early majority category, we can spread the word about the programs available to CEHD faculty. This method of dissemination will, in turn, draw in participants who rely upon colleagues' experience with technology before adopting it themselves.

The *late majority* is the next 34% of the normal distribution. This group is characterized as skeptical of new ideas, technologies, and processes. They are often placed lower on the computer equipment "food chain",

which makes innovation more difficult, from a technical standpoint. Late majority group members often adopt innovation as a result of peer and economic pressures.

The last 16% of the normal curve is the domain of the *laggards*. Rogers describes laggards as "traditional", and possessing "almost no opinion leadership" (Rogers, 1995). Firmly rooted in the past, they are the historians of a population. In CEHD, the laggards can be a very vocal group, often publicly questioning the value of innovations. It is expected that these individuals will follow form and adopt any innovation out of pure necessity.

4. Conclusion

Our informal evaluation of recent CEHD technology initiatives has revealed a flaw in the narrow focus, to date, on Web-based courseware development. However, we don't view our initial efforts as wasted time because they have given us a baseline by which to judge the efficacy of the new innovation. In other words, we "broke ground" with the template-based Web course model and will build upon that foundation in transitioning to ClassWeb as the vehicle for CEHD Web-based courses.

An equally important outcome of our technology survey revealed that CEHD personnel also need schooling in fundamental technologies. A faculty development and training program was implemented in the spring of 1998 to address these issues. These programs not only provide basic competency training in use of common CEHD software -- such as word processing programs, presentation programs, and Internet/e-mail clients -- but also provides instruction at a higher level of integrating the software into faculty research, teaching and classroom activities.

While changing the technology climate in CEHD is taking longer than anticipated, by implementing diffusion of innovation theory we will produce more meaningful results that will remain part of the CEHD community's technology repertoire for some time to come. Changes in leadership at the highest levels of the college offer additional promise of strengthening the importance of technology in evaluating faculty goals and activities. In addition, the development team hopes that framing future efforts within a more standardized development paradigm will provide opportunities for meaningful evaluation of subsequent technology innovation initiatives.

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Making the Move to On-Line Learning

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Abstract: Change is a reality in today's workforce. With every new invention and growth in technology, businesses are forced to change. One of the changes businesses are making is the adoption of web-based technology. This has greatly impacted the business of training. One of the biggest challenges the training industry is facing today is making the transition to web-based and on-line learning. With this change in direction for training and education, the role of the instructor and the student also are changing. Roles and responsibilities are becoming more ambiguous. This can lead to resistance. It is well documented that individuals and organizations resist change. In search of stability, it is natural for people to attempt to establish and maintain control over their environment. In this paper, the impact of role ambiguity, specifically that of instructor and student, on the change from instructor-led classroom training to on-line learning is explored.

1. Introduction

The topic of organizational change is not new. Organizations have been plodding through change, and the various business fads resulting in change, for decades. The training industry is currently in the midst of a major change in terms of technology and in terms of mindset.

Possibly the most important pitfall to any change process is not understanding resistance. This lack of understanding can result in frustration on the side of the change agent, the management and the employees. It can also lead to dysfunctional behavior, such as acting out against the change, the initiators of the change and the organization itself [Galpin, 1996]. Resistance can sabotage the best intentions for change. Sometimes, there is no trace or knowledge of a change effort because, due to internal resistance, the project was stalled before it really took off [Goldstein, 1988]. Therefore, it is critical that this resistance be effectively addressed, or avoided, in the first place.

2. Causes of Resistance

Many factors contribute to the success or failure of organizational change. A number of variables can result in resistance to the change efforts. Among them are: a lack of information about the change; unclear messages regarding the need for the change; unclear expectations regarding new roles and responsibilities; and inadequate reassurances of the individual's ability to be successful in the change. Gone unchecked, these variables can result in resistance to, and ultimately end in failure of, the change effort [Robbins, 1997, Armenakis, Harris, & Mossholder, 1993].

Another factor is readiness of the individuals and the organization. Readiness to change refers to the employees' beliefs and attitudes about the organizations need to change and its ability to make the changes successfully [Armenakis, Harris, & Mossholder, 1993]. People will choose tasks and goals they believe they can be successful in and tend to avoid those in which they feel they will fail [Bandura, 1997]. If the employees do not believe in the need for change or feel it will be unsuccessful, either for them or the organization, resistance will occur. Instructors and students are no different. The instructors want to be successful in their job; i.e. they want to be effective teachers. Most instructors don't truly see the need to change the way they currently do their job. They see their students walk out of their classroom having learned what they needed to. Why fix what isn't broken?

The students want to be successful in their job or role as well; i.e. they want to learn in an effective way. Classroom training has been a tried and true model for centuries. And most of the new technological fads have not proven to be as effective or as practical as classroom training.

Neither group sees the need for the transition, nor do they understand how their role will actually change. This is a great source of concern and stress for these individuals.

The instructor and student response to this change can often appear as a lack of effort, a lack of motivation, or a willful opposition to the new learner-centered model of instruction. Through this resistance to change, the employee is attempting to maintain explicit goals, roles and behaviors that have become the norm for them. Resistance, either conscious or unconscious, is their response to a real or perceived threat to their traditional norms, power relationships, and ways of conducting themselves in their job roles [Senge, 1990]. In many cases, the perceived threat is almost more potent than a real threat. People are more influenced by their perceptions and interpretations of their environment than they are by objective reality [Bandura, 1997; Thomas & Velthouse, 1990]. In a sense, resistance may function as a survival mechanism when change is perceived as a threat.

There are many variables that can cause this response of resistance to proposed change. Among them is the student and instructor belief in their ability to be successful and ambiguity regarding their new roles.

3. Role Ambiguity

Role ambiguity occurs when there is a lack of clarity between an individual and others regarding what is expected of them [Spreitzer, 1996]. Ambiguity around the expectations and responsibilities of the new job role can adversely affect the student's and the instructor's belief in their capability to perform these new work activities with skill.

3.1 The Changing Roles of Students and Instructors

In this new environment of on-line learning, the role of the student is changing from being passive recipients of information to being active agents in their own learning. The role of the instructor is changing from being the "sage on the stage" to the "guide on the side". They are becoming facilitators of the learning experience rather than the controller of the experience. For both groups, these changes are enormous. Most adults have twenty plus years of experience with the traditional classroom model of instruction. From their elementary and high school education through college and their careers, the stand-up instructor is probably all they've known. Both groups are now being asked to give up that model and adopt a new one, often times with little or no guidance as to what the new model, and their roles within it, are.

3.1.1 Employee Expectations

In order for management to provide appropriate guidance and direction to the instructors and the students, each role should have clearly articulated expectations and responsibilities. This enables them to take responsibility for their performance and for management to hold them accountable for their performance [Rizzo, House, & Lirtzman, 1970].

Ambiguity around these new roles and responsibilities prevents them from performing at their highest potential because the expectations are unclear or unspoken. If they don't know what it is they are expected to do, and how to go about doing it, they cannot become high performers. Without clear expectations, the student's and the instructor's beliefs about their ability to be successful suffers. To offset this problem, employees will often resist the change that created the ambiguity in their roles, hoping to return to the roles in which they were confident and they understood.

For the instructors, that often translates into becoming virtual lecturers. Without clear guidance and expectations in their new role, instructors will often revert to lecturing on-line, ignoring the functionality the on-line learning environment provides. Collaboration and interaction is not fully utilized. The instructors begin to feel inadequate in this new role because they have lost touch with their students. They don't feel this new environment is conducive to the type of training they are conducting. They begin to consciously or unconsciously resist the new role and the new direction of their job.

For the students, this often translates into lack of persistence in this new method of learning. They drop out of classes, don't fully engage in the activities, or simply go through the motions of the class, not

learning everything they need to be successful. Evaluations for the classes are poor. The result of this is often misinterpreted as inadequate training and the program is dropped. Unfortunately, this scenario happens far too often. Had the student been taught how to learn in this new environment, and had the expectation been set that they need to take an active role in their learning, this might have been avoided.

3.1.2 Management Expectations

Additionally, if the roles, responsibilities and expectations are not clear, management cannot provide the appropriate guidance and support to the employee to help them achieve high performance. This exacerbates the problem for the organization as a whole. Many times, management is not fully aware of the new role training is taking for their employees. Many organizational cultures and environments aren't designed to support a student in this type of training. In the old method, the student went away to training - out of sight, out of mind. In the new method, the student may be taking training at their desk. This often leads to the students being interrupted during their training simply because they are there. With constant interruptions, the student cannot succeed. If the students are not successful, the program will not be successful in the long term.

3.1.3 Summary

There are many variables that can cause this ambiguity in new roles within a changing organization. A lack of goal definition may result in goal conflict and role ambiguity across the organization [Spreitzer, 1996]. Unclear hierarchies and lines of authority create uncertainty as the employees attempt to fulfill the expectations of the many different stakeholders in the organization. In the old model, the student went to class. Their priority was the training and the hierarchy stopped with the instructor. In the new model, the student is torn between the hierarchy of their management structure and the instructor. Priorities become blurred if not explicitly outlined. Unclear expectations of the new role responsibilities and how they map to the new organization also lead to role ambiguity and conflict. And lack of communication regarding the stages of the changes and the impact to the individual's role within the organization often result in ambiguity around roles.

4. How Role Ambiguity Contributes to Resistance to Change

4.1 Factors Contributing to Resistance

There are many organizational factors that contribute to creating ambiguity around roles and responsibilities. How does this ambiguity contribute to employee resistance to change?

4.1.1 Power Shifts

Changes often involve the shifting of power from groups within organizations. This shift, real or imagined, threatens the employee's individual status and power and can make the power relationships and hierarchies unclear. As we have seen, the student now faces dual hierarchies. The instructor perceives a loss of personal power over the students in the new model because they no longer have proximal control. Too many factors are quickly becoming out of their control. These instructors must make significant adjustments to their new span of control. Those adjustments can be positive or negative. Positive adjustments often manifest themselves in personal growth initiatives, with the instructor proactively seeking ways to gain different forms of power and control, such as influence and expertise. Unfortunately, the negative adjustments often result in putting effort into activities designed to circumvent or resist the change. These activities manifest themselves as criticizing the new model, willfully failing to implement the new technology in the appropriate manner, or simply quitting their job in search of one that better aligns with their mental model.

4.1.2 Personal Control

Role ambiguity threatens personal control and creates stress. Role ambiguity creates feelings of threat and resentment toward the change and fear of the unknown. This threat to personal control directly impacts the employees' belief that they are capable of being successful in a given task. We know individuals will avoid activities they believe exceed their abilities and will undertake activities they judge themselves capable of [Bandura, 1997]. If there is ambiguity around their role, it is understandable that the students and instructors will not be as confident in their ability to be successful, especially in the initial phases of the transition. The change threatens to make them look bad. They have inadequate feelings of competence in this new, ambiguous role. This lack of confidence leads to resisting the change that they feel created the role ambiguity to begin with.

4.1.3 Summary

What does this mean for the change process and employee resistance to change? As we have seen, high self-confidence regarding new roles the students and the instructors must take on and clear expectations regarding those roles are key to them choosing to take on the role and persist in that choice. Continued high self-confidence, clear, concise and timely communication, and continued monitoring of effort by both the employee and the manager are instrumental in persistence in the new role. Without both, resistance can and will occur.

5. What can be done to intervene?

Given the potential for resistance to change due to role ambiguity, what can be done to develop motivation for the change and a shared understanding of the expectations and responsibilities of the new roles of student and instructor? The first and most important thing to do is to understand the reasons for the resistance, in this case, ambiguous roles. But we must go beyond that to the root of the resistance, which is understanding what is causing the role ambiguity. There are several strategies for dealing with resistance, including communication and participation.

5.1 Communication

Communication and goal setting are key to overcoming any resistance to change. This is done with careful, well thought out, clear communication that clearly articulates what is changing, why it is changing, how the process will proceed, when the stages of change will occur, and who is affected.

Another key mechanism for avoiding resistance to change and role ambiguity is a clear message articulating expectations for the individual's role within the organization, and the individual's ability to be successful in the change. Clear goals regarding the change and the new roles are instrumental in avoiding role ambiguity and role conflict. The message should clearly articulate how their roles will be migrated and what the effected individuals and groups can expect.

Managers and change agents must provide adequate information about the change and the new vision and strategy. Information about organizational vision and strategy is important because it helps to create a sense of meaning and purpose. By understanding where an organization is headed, individuals can begin to understand how their work roles and behavior affect its success [Frey, 1993]. Access to organizational information also allows individuals to see the big picture and develop a frame of reference for understanding their new roles within the organization [Bowen & Lawler, 1992].

5.2 Participation and sponsorship

A study by Coch and French (1948) demonstrates the value of allowing employees to participate in the change efforts. Much of the change literature recommends employee involvement in the form of change process teams, including integration teams, improvement teams, and steering committees. Not only

does a team tend to create a better result than a single individual, but employee buy-in to the change is more likely if they have respected representatives involved in the process [Galpin, 1996; Armenakis, Harris, & Mossholder, 1993; Manz, Keating, & Donnellon 1990].

From a motivational perspective, high involvement interventions facilitate the employee's trust in an organization and increase the individual's sense of control and identification with the new organization, their new roles and how they fit in the organization.

Clearly, the change agent's role and the management sponsor's role in communicating the change process and actively involving the employees in the change is critical to achieving successful change.

The following are specific interventions management can implement to help the effected instructors and students during the transition to an on-line learning environment.

5.3 Instructor Interventions

Below are a few suggestions for enabling successful instructor change:

- If possible, involve the instructors in the choice of on-line tool.
- Give them the opportunity to experience the new environment from the perspective of the student, preferably in the same type of training they conduct.
- Ensure the instructors have adequate tools available to them to gauge student involvement and engagement, and ensure they know when and how to use them.
- Engage them in the development of the instruction so they and the instructional designer fully understand the implications of the methods of training they are choosing. For example, the choice of collaboration verses single-student activities must be weighed carefully and designed appropriately into the instruction.

5.4 Student Interventions

Below are a few suggestions for enabling successful student change:

- Ensure there is an adequate adjustment period to this new method of learning. Some students do not know how to learn on their own. They may need additional guidance in acquiring these skills.
- Create a culture and environment that is supportive of learning on the desktop. Managers may need to run interference for their employees to ensure they are not interrupted while attending on-line training sessions at their desk. Some companies installed local training kiosks where students can go to take training in a quiet, undisturbed environment. Others have initiated the use of symbols that identify when an individual is actively involved in training at their desk and that they are not to be disturbed. Some such symbols range from little flags posted in the cubes to signs outside their work area.
- In the initial phases, monitor the student's progress and provide external motivation support as appropriate.
- Build into the training some mechanism, even a manual one, to allow the student to self-monitor their progress and engagement levels, as well as allowing the instructor to monitor their progress and engagement.
- Conflicting priorities may make persistence in learning at their desks difficult. Managers may have to help their employees with priority management.
- Give them adequate equipment to fully utilize the features and functionality of the on-line environment.

6. Conclusions

A major change such as the transition to on-line learning involves new roles and responsibilities for the instructors and the students. If the change and resulting impact to student and instructor roles is not clear, overt or covert resistance can and will occur. Management is responsible for ensuring their people are fully prepared, both from a skill perspective as well as a confidence perspective, to successfully make this transition. Through interventions of communication, participation in the change process, and skill development, the resistance fades as employees begin to understand, and become confident in, their new role within the organization [Manz, Keating, & Donnellon, 1990].

The implications of overlooking employee confidence, role ambiguity and their respective impacts to the change process and the organization as a whole are enormous. The change to an on-line learning environment itself is at risk if the individuals involved in it are resistant and do not buy-in. It is clear that communication and clear articulation of the change and what the change means for them and their role is key to successful change efforts.

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Enabling Technologies for Adult Distance Learners

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Abstract: Adult education and distance education are two of the fastest growing segments of the education market. Technological and procedural improvements need to be focused concurrently on three domains: course delivery technologies, course/program administration and course content. Delivery technologies, such as satellite, CATV, CD and World Wide Web, are perhaps the most visible area of change. Administrative procedures can benefit from both process re-engineering and emerging technologies such as WWW, touch-tone, speech recognition and FAX. Improvements in course content have the potential to benefit both traditional and non-traditional students. The Lockheed Martin Engineering Management Program at the University of Colorado serves as an example of both progress that is possible in these areas and of the improvement opportunities that yet exist.

Introduction

The Lockheed Martin Engineering Management Program at the University of Colorado is celebrating its tenth anniversary. The program was originally chartered by Martin Marietta to provide professional and graduate education over live one-way video, two-way audio links. Over the span of a decade, the program has grown to serve on-campus, live video and video tape students across the country and around the world. The program has a vital interest in the junctions of distance education and adult learner theory and practice.

There is currently a rush by colleges and universities to implement distance education [Sherron and Boettcher 1997]. After decades of steady, unspectacular growth, adult education has seen explosive growth in recent years [Merriam and Brockett 1997]. Adult education, or andragogy, is the fastest growing segment of the education market [Bedensteiner, 1989]. To fully realize the potential of distance education for adult learners, advances must be made simultaneously on three fronts. First, improvements are required of the distance education (DE) delivery technologies. Also, administration of these programs must remove unnecessary barriers for distant adult students. Finally, the quality of the course content delivered by these new technologies must improve.

Delivery Technology

The capabilities of emerging DE delivery technologies, particularly bandwidth and ease-of-use, must increase to fully realize the potential benefits. These technologies need to be more affordable in order to realize the promise of broad-based access to life-long learning. Standards must emerge among DE technologies to reduce the risk of purchase. The emergence of standards will tend to facilitate the desired outcome of lower costs [Moore 1993]. However, adoption of standards tends to inhibit the development of new features and capabilities [ibid.]. In weighing the trade-offs between technology capability and student access to technology, the Lockheed Martin Engineering Management Program currently requires video tape player access (typically, but not necessarily VHS) and 28.8K dial-up Internet access as minimum technology requirement standards for

students enrolled in the program. These standards are evaluated as a function of two criteria. First, the affordability, availability and standardization of new delivery technologies is considered. Second, changes in course content may drive new delivery technology requirements. This second consideration suggests that the delivery technology and course content domains are not mutually exclusive.

When properly executed, distance education promises several benefits [Porter 1997]. Distance education can provide greater educational opportunity for a more diverse student population and students should be able to utilized their preferred mode of learning. Distance education has the potential to promote more teacher-to-student, and especially, student-to-teacher and student-to-student information sharing. DE delivery technologies can enable greater interaction outside of normal class hours. Distance education ought to encourage both student and instructor exposure to new technologies.

Adult learners are more diverse in many regards [St. Pierre 1990], so they should benefit to the extent that DE provides greater opportunity to a more diverse student base. Adult learners prefer self-directed, self-paced instruction [Zemke and Zemke 1982] and they stand to benefit if the DE delivery technology enables them to utilize this preferred mode of learning. Adult learners want to share their relevant life experience and often desire contact outside of normal class hours [ibid.], so the intersection of distance education and adult learning appears to hold much promise.

Of the DE benefits cited by [Porter 1997], only the exposure to new technologies poses a potential barrier to andragogy. Adult learners are less likely to tolerate discomfort in the learning environment [Zemke and Zemke 1982]. They are less tolerant of trial-and-error learning experiences, tend to take mistakes more personally, have trouble integrating more than one new concept at a time, expect new material to be immediately relevant to their situation, and desire to have new material be consistent with what they already know [ibid.]. Therefore, what is seen as a beneficial characteristic of DE in the context of pedagogy can inhibit adult learners. This problem is particularly acute with CD- and web-based hypermedia because there are no widely accepted principles for organizing the multi-dimensional electronic information space [Bevirt 1996].

Professors in the Lockheed Martin Engineering Management Program employ consistent means for organizing and navigating hypermedia instructional aids on the program web site. First, the program curriculum web site (http://www.colorado.edu/EngMgmtProg/courses/) is organized sequentially by course number with hierarchical links to course pages. All courses in the degree program have such a course page. Not all courses provide every category of instructional aid, but aids that are present within a given course are hyperlinked in a sequence which is consistent between courses. The proposed organization of material within a given lesson or instructional unit is covered in detail below.

Administration

[Bedensteiner 1989] has identified administrative barriers for adult learners. These include inflexible course scheduling, complex registration processes and a lack of openings for non-traditional students in traditional classes. DE technologies have the potential to increase the flexibility of course content delivery and free students from the constraints of time and space [Porter, 1997]. Simplified registration processes, allocation of course openings for adult learners, and special orientation sessions for adult students are recommended to help overcome these barriers [Bedensteiner 1989].

Numerous barriers have been identified in the administration and staffing of distance education programs [Olcott 1996]. Residency requirements for distant students seeking degrees form a significant barrier to distance education. Many programs are plagued by a lack of resources particularly, but not exclusively, infrastructure resources. Disputes as to whether faculty efforts with respect to DE programs are inload or overload activities hamper the implementation of distance programs. Faculty are reluctant to participate in DE

programs because of concern about applicability toward promotion and tenure. Faculty express concern about a loss of control, both of their perceived intellectual property due to new distribution technologies, and loss of instructional control as specialists such as program directors and multimedia programmers become more integral in course delivery.

The Lockheed Martin Engineering Management Program is centrally administered through the Center for Advanced Training in Engineering and Computer Science (CATECS) in the College of Continuing Education at the University of Colorado. CATECS is chartered with providing the infrastructure resources to successfully deliver distance education programs. CATECS provides a simplified, one-stop interface for students to other University services and administration including registrar, bursar and book store. The majority of CATECS students are adult distance students, so they receive top priority in course enrollment. The Lockheed Martin Engineering Management Program conducts a special orientation session annually for new entrants.

In their last semester of enrollment, degree-bound students are transferred from Continuing Education to the Graduate School and their residency requirements are waived. The University of Colorado is in the final stages of approving a collegiate professor career track that is specifically designed to foster the career development of faculty whose main focus is instruction and those that work primarily with non-traditional students. Control issues have arisen within the greater CATECS community, but Engineering Management faculty appear to genuinely appreciate the input and support of broadcast and programming specialists. Password protected web sites plus video tape distribution and collection procedures are used to limit distribution of course materials to authorized students and protect the University's intellectual property.

Course Content

Regardless of the course delivery technology and whether students are "traditional" or not, a program of instruction should adhere to certain principles of teaching and learning [Cyrs and Conway 1997]. The instructor must communicate expectations, be accessible to students, involve them in the learning process, promote cooperative learning, provide prompt feedback, and encourage contact outside of class. To achieve and maintain these principles, Engineering Management faculty use an array of technologies including e-mail, listserv, HyperNews, FAX, long distance and voice mail.

In addition, the instructor should help the students visualize course materials and should reinforce materials through analogy and metaphor [Gagne 1977 as cited in Markowitz 1990]. Video tape, CD, and the Internet provide powerful tools for dynamic visualization that are not available in traditional class room settings. In the Spring 1998 semester, props and "word pictures" [Cyrs and Conway 1997] were utilized in a product development course to aid in student visualization and create visual analogies for course concepts. Early anecdotal results suggest that students are responding favorably to these initiatives.

A complete learning experience will also provide the student with an opportunity to apply the new material and integrate it with existing knowledge [ibid.]. The majority of students in the Lockheed Martin Engineering Management Program are practicing engineers or technology managers. This provides students with "laboratories" for the application of course materials that are impractical for a university to provide.

Instructors must motivate students to attend to the course materials as they are being delivered. Interactive study guides [ibid.] are also being utilized in our product development course as a means of improving student attention and motivation. These guides originally met with mixed reviews from the students, but the students have been enlisted in revising standards for the guides with positive results. An example of such a guide is at http://www.colorado.edu/EngMgmtProg/ism/isg01.ppt

Another principle of teaching and learning is respect for student diversity and different learning styles [ibid.]. The options of live broadcast and video tape provide Engineering Management students with two alternatives for different learning styles. An expanded video-on-demand pilot via Internet and CD is scheduled for the Spring 1999 semester product development course. Though video delivery through these media generally results in lower resolution video, the main advantage is random access to course materials compared with the sequential access offered by video tapes.

In addition to technology demonstration, a key objective of the pilot program is to develop a consistent organization of instructional aids between lessons and between courses. Though the organization is likely to change as a result of lessons learned from the pilot, the initial organization scheme is presented here.

Each lesson includes a title or cover page stating the course name and/or number and the sequence number and/or date of the lesson within the course. The cover page includes hyperlinks to: the interactive study guide for the lesson, the table of contents for the lesson slides, and the first slide of the lesson. The cover page also includes hyperlinks to download any viewers or plug-ins required for the lesson and links to contact the instructor.

Each lesson is decomposed into slides. Slides are generally viewed sequentially, but the table of contents for each lesson facilitates non-linear review of the slides. Each slide includes four areas: the slide image in the lower left corner, an icon returning the user to the lesson cover page in the upper right corner, a horizontal navigation bar in the upper left corner, and a vertical tool bar in the lower right corner. The slide image presents the unique material to be covered at this point in the lesson, while the cover page icon, navigation bar and tool bar are intended to be consistent across slides, across lessons, and across courses. The navigation bar and tool bar are orthogonal [MacLennan 1983] since the navigation bar represents movement within the current lesson and the tool bar represents resources outside of the current lesson.

The navigation bar represents an ordinal scale [Agresti 1990]. The left-hand icon takes the student to an absolute location, the first slide in the lesson. The next icon takes the student to a relative location, the slide immediately preceding the current one. The middle icon on the navigation bar provides the "origin" for the ordinal scale; it takes the student to another dimension composed of additional multimedia resources that elaborate on the current slide. For example, the middle icon may take the student to a relevant video clip or simulation. The remaining two icons on the navigation bar are complementary to the first two icons. The fourth icon takes the student to the relative position of the slide immediately following the current one while the last icon on the navigation bar takes the student to the absolute position of the last slide in the lesson.

The tool bar represents a nominal scale [ibid.]. The top icon permits the student to contact the instructor via e-mail. The next icon provides the student access to the threaded course discussion list. Once the student has entered the threaded discussion area, (s)he can view discussion questions posed by the instructor, respond to discussion questions, view the responses of other students, or pose their own discussion question to the list. The bottom icon on the tool bar guides the student to the home page for the University of Colorado library system. Once there, the student can search for literature by title, author subject and keyword.

An example that illustrates the principles discussed in this section is available at http://www.colorado.edu/EngMgmtProg/ism/after.html.

Conclusion

Realizing the full potential of distance education for adult students requires that administration, faculty, specialists, students and technology work in concert. Technology capabilities, affordability and standards are still emerging. While waiting for the DE technologies to mature, education organizations should focus on streamlining administrative procedures and improving course content.

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Improving Employee Awareness with an Intranet

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Abstract: Intranet technology that has been producing very good results to integrate the day-by-day activities of employees. This technology allows better communication among people in a company and can provide information and services in an easier and even more interesting way. This paper describes the experience of an Intranet development in an airline company in Brazil. The motivations for this project combined interests from the Information Technology Department and interests from the Human Resource Department. From the point of view of the first department, the introduction of web culture in the company was very important, while from the point of view of the second, to improve the awareness of employees about Human Resource policies was the main objective. Together, these two objectives guided the development of this project.

1. Introduction

Internet technology has successfully entered companies as a new working and communication tool with the outer world. More recently, the same technology has been widely accepted as a tool that enables different forms of communication inside an organization. The term Intranet was coined to represent this use.

The objectives of establishing an Intranet can vary, but to inform the employee is the bottom line of all projects. In most projects, enhance collaboration is an important goal, mostly implemented through e-mail and groupware software. Other goals that we can easily find in business institutions are to distribute information found in legacy systems and to support the fabled paperless office.

In this article we describe and discuss the implementation of an Intranet in a medium sized airline company in Brazil. Enhance employee awareness in relation to the company Human Resources (HR) policies were one of the main motivations. The HR Department of the company had detected that employees had very few informations about benefits available and how to use them. The cause of this problem was that employees didn't read most of information that was distributed in traditional media, like posters, mailing and even email. They treated most company official communications as *junk mail*.

The proposed solution was to provide an internal web site that should be very appealing to the employee, giving information they find interesting, while, at the same time, feeding them the information that the HR Department had previously determined to be lowly disseminated. The site should work as a lure.

Another main characteristic of the problem was the lack of computer access of about half the company employees. To compensate for this, we also decided to establish Intranet kiosks in special places.

As results we managed to improve employee satisfaction in relation to HR benefits, since now they know what are and how to find their rights, and created a new culture in the company not only to distribute information, but also to implement possible systems in the future.

In this article we will describe the project, how it was developed, methodologies, problems, implementation and results.

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2. The Company

Rio Sul Linhas Aéreas is a regional airline company that flies inside Brazil, with offices spread across the country and about 2000 employees with highly different profiles, from aircraft pilots to programmers. The offices are connected by a TCP/IP WAN and the company has approximately 500 computers connected to it.

The employees can be classified in two groups: staff and crew. The crew, 54% of all, is composed of pilots and stewardnesses, i.e., people whose job function is to fly, while the land-based employees compose the staff. The main difference for the project between the two groups is the access to computer. While most of the staff has a computer at hand, sometimes even on his/her desk, and is used with email technology, the crew has no computer access but for the avionics equipment. Since communication with crew was the most critical problem detected, the solution had also to modify this situation.

The crew is a very special group in airline companies. While most employees in any company work inside the facilities, and have a long time to interact with their co-workers, crewmembers spend most of their time flying. Usually they arrive at the airport minutes before the departure of their airplane, do some bureaucratic and technical tasks and go for the airplane. The only opportunity of being available in an environment that is somewhat similar to an office is when they are in backup, i.e., waiting in a special premise in the airport to substitute any crew member that cannot fly for any reason.

3. The Project

3.1 Motivations

The Intranet project started with the synergetic collaboration of two departments of the company. The HR Department was for a long time trying to find a solution to the lack of knowledge employees had about their benefits. The Information Technology (IT) Department, in a innovation cycle, had just signed up a collaboration contract with one of the most important computing research centers in Brazil and desired to introduce Internet and Intranet culture in the company, aiming at further uses of this technology in systems to enhance productivity.

Searching for a company sponsor, the information manager proposed to use the launching of the Intranet to solve the HR problems. In this way, IT Department had a big and unexpected challenge: how to make crew use the Intranet.

After a few meetings, the inter-department group decided set the following strategic objectives:

1. disseminate the Intranet culture;
2. provide up to date information and services that would attract the employees;
3. improve employee knowledge about benefits, and
4. Attract other departments to participate in the Intranet.

3.2 Building a Team

One of the first problems when starting an Intranet in a company is the lack of skills found in the conventional in-house development teams to deal with the different techniques and knowledge needed for Web development. In this case the company decided to hire new people, composing different skills in a multidisciplinary team. It was clearly necessary to have a multimedia programmer with previous experience and a graphical designer. To this, it was added a consultant from the Computer Research Center, guiding the team on choosing and following processes, methods, development tools and general contents organization. Further on, the team needed an aditional programmer, able to solve some database connectivity tasks.

Some people from the network and operational systems support were also considered extremely important, but it was not necessary to add more people besides what the company's support group already had.

During the development, HR collaborators also actively participated in every decision, building a participative design framework. These collaborators created or provided the basic information for most of the Intranet's content.

3.3 The Development

The development started with organizing several interviews including people from the Information Technology Department and from the Human Resources Department. The objective of these meetings was to separate all possible information from the HR Department to be present at the Intranet.

Since the HR Department is divided into four areas (Personnel area, Recruiting Placement and Training area, Benefits area and Endomarketing area), at least five interviews were necessary. One with the main manager with the objective to catch a broad view of the department, and four others with the sub-managers to catch specific views of each area.

The method to drive these interviews was based on opened explanation by the person from the HR Department and the Information technology department group made driven questions as well.

All the interviews were recorded in tapes and further the IT Department produced a document so that all the participants could confirm what was said during each interview.

After all the interviews some topics were chosen to be included on a first project that had to be developed in 1 month and a half.

The following steps were to define Intranet's architecture, the technologies to implement it, to begin the building phase and to test the site

3.3.1. Intranet Architecture

From the chosen topics to be included on the Intranet and considering its evolution with other company's areas, we defined its architecture. The information/services were divided into three main groups: the fixed topics, the utilities and the general application area, see Figure 1. They are detailed below:

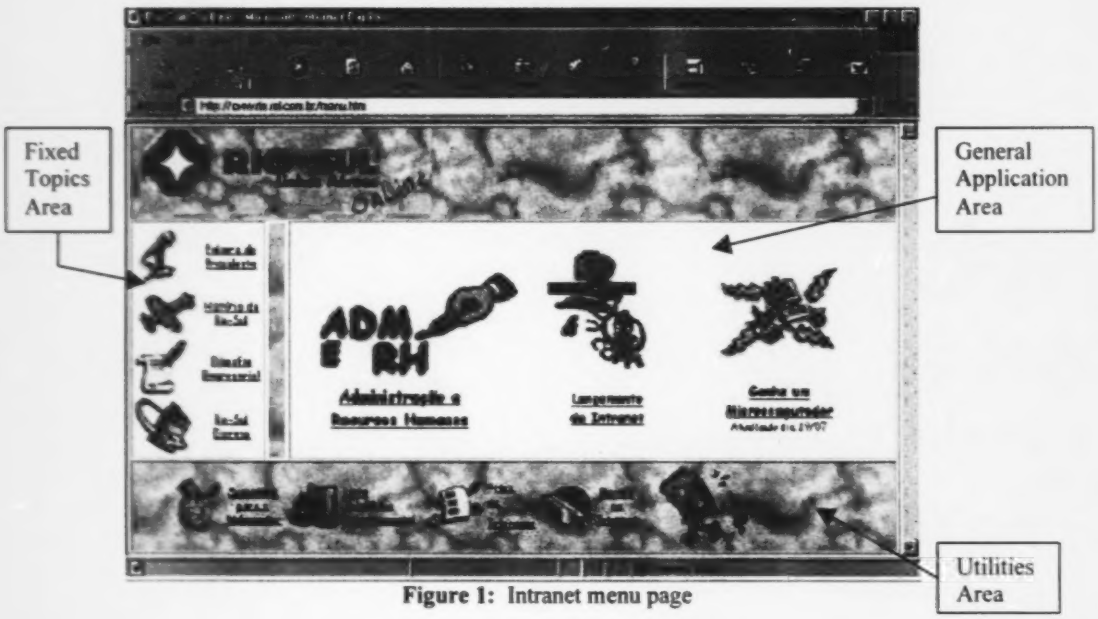

Figure 1: Intranet menu page

➲ Fixed topics are the topics that are not updated so frequently and include:

- The Speech of the Company's President
- The Company's History
- The Company's Philosophy
- The Group of Internal Magazine on-line (this topic is updated from three to three months approximately)

BEST COPY AVAILABLE

➲ Utilities is formed by topics that can be applications/systems and groups of information that does not belong to any specific sector and can be useful to all employees in the company. They include:

- Web Mail
- General Phone List (with the main people)
- A List of Interesting Sites related to aviation
- The News Area, where we can find some software to be downloaded, some wallpapers and frequent news too
- A direct link to the Internet Web site of the company
- A direct link to the Intranet's webmaster e-mail, providing communication between the user and webmaster to give suggestions and complains

➲ General Application Area are all other information or service provided by some company's area and can be general or protected

➢ The first area to participate was the HR Department providing the following topics:

- Access to the payment-check - through individual password database access
- A list of benefits composed of explanations about the benefits provided to the employees
- A list of outsource companies that work for the Recruiting Placement and Training area
- A list of health insurance companies that maintain agreements with Rio Sul
- Explanation about employees' security during their daily activities, security equipment and security methods

➢ The second topic available at the General Application Area is about the project itself, including information about the Intranet Launching and the Research Center participation.

➢ The third topic available at the General Application Area is about an award (a microcomputer) provided by the IT Department to the new areas that are going to participate in the Intranet, with information, services, applications, etc. The proposal of this award was to use it as a lure so that other areas would get interested in participating the Intranet. The Information technology department defined a deadline to accept the proposals, which has to be developed following some guidelines also available on the Intranet.

Since there are company's offices all over Brazil, with the main ones in Rio de Janeiro, São Paulo and Porto Alegre, it was necessary to define how all the network users would be connected to the Intranet.

To guarantee a good Intranet performance it was decided to keep three Web Servers separately. One in each of the main cities and the users would access them with different URL's. So, people connected directly to São Paulo network would use the São Paulo address and the same was true to other cities.

But, there was still a big problem to be solved. The crewmembers did not have any computer to be connected to Intranet. The decision was to provide a desktop machine (kiosk) on the airport in the area where they spend part of the time waiting to fly. More specifically, during the time they work as backup for other crew people that are going to fly and may not do it. This way, all the employees have computer access and, consequently, can use the Intranet.

3.3.2. Technologies

The technologies used to implement the topics were basically: HTML files, for static information and ASP files for database access.

The Web Server used was:

- Microsoft Internet Information Server 3.0 running on Windows NT Server 4.0;

The development tools used were:

- Microsoft Visual Interdev 1.0 to manage the site;

- Microsoft Front Page 98 to create HTMLs files;
- ASP 2.0, built through Visual Interdev, and
- Since the corporative DBMS (Data Base Management System) is Informix, we decided to keep with it, using Intersolv ODBC version 3.01.

The browser chosen to be the standard in the company was:

- Microsoft Internet Explorer 3.02, without any plug-in;

3.3.3 The Building phase

After all the content and technology definition the building and setup up phase began.

At this time all the team started working at each specific need.

The Network support group was responsible to install the software on the development Web Server, while the visual programmer worked on the images and the other two programmers divided their time, between collecting material and defining the HTML content with the HR team and programming the database access.

After one month and a half, all implementation was ready to be tested. Surely, there were several problems with machine's setup, software configuration and, mainly, database connection. All of them were solved so that we could begin the test phase.

3.3.4 The Test phase

Just the group from the Information technology department performed the first tests. HTML files were tested in different browsers' configuration and versions. Navigation, buttons, images, HTML tables, frames, Gif animations were also tested. The functionality of database access was extremely tested too.

The second group of tests performed, included the leader of each area. The Intranet was put on-line, in an URL for test and the users were asked to validate all the information and test, navigation, images and so on.

After both tests, some changes were necessary and some tests were repeated.

When all people involved agreeded with the end of tests, the production phase was initiated.

3.3.5 The Production phase

Intranet and Internet technologies were new at the company. Regarding this fact, it was decided not to put the three web servers on-line, simultaneously, to prevent from having troubles with the distributed setup, sites and servers. It was fixed a time to put the site on-line, first in Rio, then São Paulo and after Porto Alegre.

The Intranet's launching, in Rio, was done by e-mail, some posters spread in the company advertisement board and each employee working in this city also received a letter including her/his personnel password to access the payment-check through the Intranet.

Since July 28, 1998 the offices in Rio are using Intranet. There are approximately 200 users already connected to the web. São Paulo is going to be set in the end of September, when all the crew is going to start using the Intranet and further Porto Alegre, in the end of October.

3.3.6 Difficulties

Although the results have been very positive, we had a lot of obstacles to overcome.

First of all, the setup of all hardware and software and this observation is just to confirm the real value of having an interdisciplinary team. Each component of our team participated with some valuable suggestion.

We also had some troubles not directly dependent on people, money or time and neither could be easily solved. For example, one of the main focuses of this project is to spread information to employees who are not

present in the company, specially the crew group of employees. However, the National Airport of Rio de Janeiro was 100% burned and, as a consequence, it was impossible to install the Intranet to the crewmembers.

3.4 Conclusion

The results of this first phase are related only to the production phase in Rio.

The first results were made by e-mail to the webmaster. Few were about doubts considering the text interpretation. Some considered topics that the user was satisfied to find on the site, for example, the list of benefits. Some also considered compliments to the visual aspects of the site and, finally, there were several suggestions which are being put in a suggestion list (Figure 2) and are already being analysed to be built and included on the site.

Suggestion List
An advertisement area
A download area containing general use documents from the Personnel Division
A system to allow update information for the Personnel Division electronically
A table of payment days for the whole year
The telephone list of the whole company, made through database access
FAQ about web use
Flight time-table with bussiness flights
A protected help-desk system

Figure 2: Examples from the suggestion list

Another point of view that contributed for user satisfaction was the Internet availability. Several users were motivated to have the opportunity of using the web technologies.

The payment-check and the list of benefits have been the greatest stars of the Intranet and with this new way of providing information, we are reaching our main objectives of spreading the web culture and to improve the employees' knowledge about the HR policies.

The next steps of the project are, to install the Intranet in São Paulo and Porto Alegre. Parallel to this some new topics are being introduced, based on some HR requests and user suggestions.

Acknowledgement

The authors wishes to thank all the Intranet cotributors without whose participation, interest and patience this project would not have become a reality. They are friends from: the Information Technology department, the Personnel area, Recruiting Placement and Training area, Benefits area, Endomarketing area , the Marketing Department and COPPE/UFRJ. Your valuable contributions make this project special!

The Use Of ActiveWorlds In Education In The Netherlands

Abstract:
In this poster-presentation the use of Internet in Secondary Level Education by using ActiveWorlds will be peresented. Within this Website students of schools in The Netherlands, Russia and France are building a virtual 3D-world with help of their teachers. In this world educational applications are being build within a number of subjects. In ActiveWorlds teachers and students communicate with teachers and studens in other schools within the Netherlands and abroud. This kind of communication is an important contribution in education of foreign languages, which is a very important element in the curriculum of the Dutch education-system. In this presentation we present in the first place the ICT-situation in schools in The Netherlands. Further we show what has been build in Active Worlds and how students and teachers use it.

Developing Web-Based Distance Education Courses: A Tool for Non-Developers

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Abstract: As a provider of enterprise-wide administrative software to colleges and universities for some 30 years, Datatel recognizes the need to embrace the entire campus family – administration, students and faculty. This paper describes a pilot project to address the needs of faculty seeking to develop web-based distance education courses without having to learn programming or be dependent on professional programmers and Web developers. The project is divided into five phases: (a) qualitative research among faculty at Datatel client sites to obtain an understanding of faculty workflow; (b) review of tools currently available for developing web-based distance education courses; (c) process of selecting tools to solve potential problems at each phase of the faculty workflow; (d) proof of concept of the total workflow solution; (e) refinement of the total workflow solution.

Overview

Faculty members are being increasingly challenged by the need to balance pedagogical requirements and goals with their institution's need to push forward with technological innovations to gain a competitive edge. IT staff, particularly the chief academic computing officers, view assisting faculty with integrating technology into instruction as the greatest IT challenge facing their institution [Green 1997]. The growth in the number of institutions offering distance education courses has added to the pressure on faculty to become technology savvy.

IT departments have been looking to administrative software providers like Datatel for integrated, enterprise-wide solutions for the entire campus family – administration, faculty, students. To facilitate this partnership between teaching and learning on the one hand, and technology on the other, Datatel's Enterprise Resource Management solutions should help move faculty through each step of its workflow, just as we do for the administration. This paper describes a pilot project currently underway at Datatel to help faculty develop web-based distance education courses without having to learn programming or be dependent upon professional programmers and developers. The project is divided into five phases: (a) qualitative research among faculty at Datatel client sites to obtain an understanding of faculty workflow; (b) review of tools currently available for developing web-based distance education courses; (c) process of selecting tools to solve potential problems at each phase of the faculty workflow; (d) proof of concept of the total workflow solution; (e) refinement of the total workflow solution

Project Design

In order to offer solutions, we needed to understand faculty workflow and identify potential problems at each step of that workflow. Figure 1 illustrates faculty workflow based on feedback from Advisory Committees drawn from faculty at Datatel client institutions, as well as discussions on faculty listservs and conference papers. Faculty must first find out from the administration what the teaching load is for the coming semester, then move on to designing the instructional method. Today, the instructional method depends to a great extent on the delivery vehicle – traditional classroom, with or without web support, partial or total distance education. Nevertheless, the objective is to apply pedagogical best practices regardless of the method of course delivery [Spear 98a]. The next step in the workflow involves actually putting the course together, and it is usually at this point that faculty members developing distance education courses call upon their IT departments for assistance. Once the course is developed, it is taught, and at its conclusion, final grades (or other performance measures) are submitted to the administration.

This workflow looks fairly straightforward, but instructional design and course development are particularly challenging for faculty charged with developing web-based distance education courses.

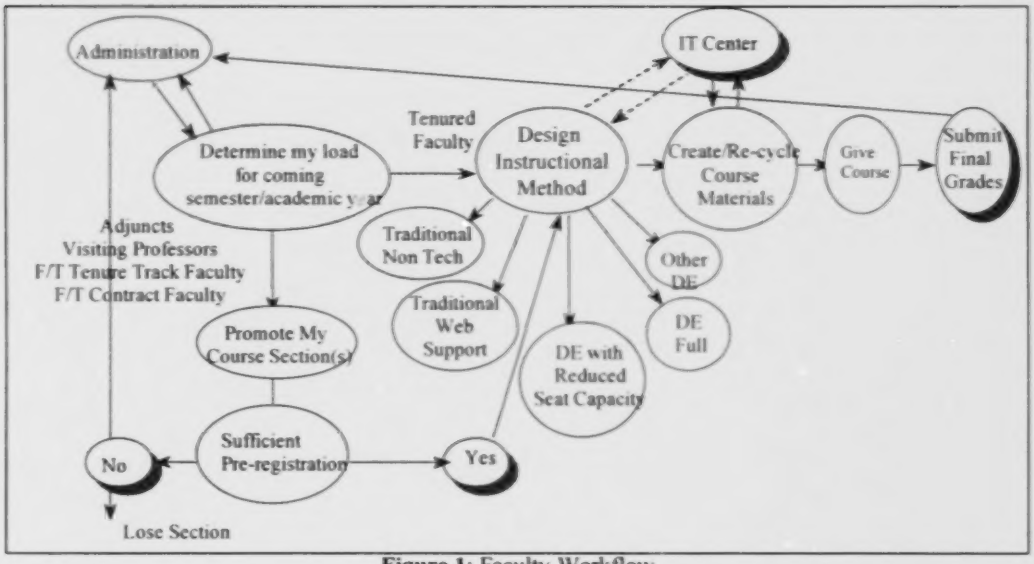

Figure 1: Faculty Workflow

The next phase of the pilot project involved an in-depth review of the tools currently available for developing web-based education courses. Creating course materials is the most time consuming, resource-intensive portion of faculty workflow and there are a variety of shrink-wrap products for authoring. Authorware and ToolBook II are examples of PC-based authoring tools that now have full web capability. However, nearly all of the PC-based authoring programs require a fairly robust technology skill set to get beyond on-line page turning; few provide development assistance and none integrate or interface with the institution's back office administrative information systems. Distance education course management systems such as CourseInfo, WebCT and Learning Space address web-based course administration and communication and have authoring tools that are relatively easy to use. However, they are not nearly as rich in functionality as the PC-based authoring tools.

Does ease of use always mean sacrificing authoring flexibility and functionality? Will web-based courses that are both pedagogically sound and feature-rich be produced only by faculty who are or have access to Web developers and professional programmers? A good authoring tool should provide step-by-step creation methods, templates, sample Web pages that can be adapted for individual use, automatic generation of CGI scripts, and basic instruction for creating standard components [Hansen and Frick, 1997]. But the authoring tool should also be flexible enough to provide the functionality and the benefits of multimedia tools and integrate seamlessly into whatever distance education course management system the institution has selected. The third phase of the pilot project involved the assessment and selection of MICROCOSM PRO [HREF1] as the authoring tool that meets all three requirements: ease of use, rich in functionality, seamless integration. Created by a university consortium in the United Kingdom and winner of several international awards, MICROCOSM PRO offers a faculty member the capability of producing the same kind of multimedia, interactive courseware that a professional developer produces, but without the developer. What differentiates MICROCOSM PRO from other authoring tools is its open hypertext technology. Instead of having to translate your resources to suit the proprietary formats that those tools use, MICROCOSM PRO uses a series of built-in viewers to access the resource files. For example, there are viewers for each of the MS Office applications, for AutoCAD, for GIF and JPEG files, etc. When an author creates hypertext links, the links are stored separately from the data in their own link

database. This means that the resource materials can remain in their native formats and in their native location. Moreover, the courseware can be created and utilized in a non-linear fashion. Instead of page-turning on-line instruction, the course design is interactive. It is learner-centered, so that the student working through the materials is free to create his/her own glossary and links without disturbing what the instructor has done. Importantly, it is faculty friendly. Task cards and wizards in plain English step the faculty through the creation of the course, with lots of positive reinforcement along the way. Once the course is created, it can simply be "dropped" into the institution's course management system via a Publish-&-Go wizard.

The final phases of the project involve benchmark testing of MICROCOSM PRO's "fit" with the various course management systems, as well as integration with the institution's back office administrative information systems. This will be accomplished in partnership with selected Datatel client institutions.

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Virtually Open University
- Open University of Helsinki Opens Up on the Web -

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Abstract: *The Finnish Ministry of Education has a national strategy for providing information society skills for all citizens. The Open University of Helsinki is taking part in this strategy by providing access to its services through the Internet, thus extending the distance education concept. The project is founded by the Ministry of Education. This paper provides an overview of the project and details some experiences on virtual teaching in general and on a basic computer science course in particular .*

Open University: A Brief Overview and Project Objectives

The open university, part of the university and not a separate educational organization, is open to all, regardless of age and educational background. The teaching is equivalent to basic university teaching, and is offered at low cost by law. All goals of study are equal to universities and all study is part-time. The teaching is realized through a cooperation network, with 300 cooperating organizations.

The Open University of Helsinki coordinates the national virtual open university project, founded by the Ministry of Education, with 19 Finnish universities providing their course data. With 6,000 courses, the volume of information is quite high. However, the national database contains only course information and general guidance.

While the national course database provides an easily accessible, user-friendly virtual environment for educational information, it cannot be easily modified to the needs of individual open universities. Thus, the Open University of Helsinki began its own project to make it easier to provide current information to all personnel with easy updating and coordinating possibilities and online services to our customers. But what began as an extended online database of course information has expanded to a full-scale information system providing most of our services on the Web and some new services made possible by the Internet.

Web Services

The Open University of Helsinki has 23,000 students and 15 years of experience in distance education. Thus, it is a natural development to extend our services to the Web, where they are divided into Student and Personnel Services. Our basic student office services (registration, ordering of studying materials and credit summaries, counseling and tutoring, signing up for exams, and checking exam results) are easily adapted to the Web and indeed enriched by it: Virtual courses for improving study skills, online counseling at set hours, office routines anytime without regard to office hours. Payment, however, is not possible through the Web yet.

The personnel also benefits because students can perform some repetitive tasks themselves. Thus, the personnel has more time for individual counseling. And since all course information is centralized to one location, all updates are immediately available to everyone. The national database has been modified in our project to include special fields and features that help our course designers to plan courses together as teams. With groupware capabilities, personnel in different cities can easily develop and update documents together. Personnel services also include new and effective ways for searching information, tools for teachers, an open university handbook, and a forum for interaction.

Not only is all our current course information accessible anywhere anytime, we have also designed some new Web-based courses based on current courses. We do not, however, design courses just for the Web: All our courses are also always available in more traditional forms (classroom teaching, distance education, and individual studies). Some of the courses are a combination of different

forms; The Web, Classroom Teaching and Group Work. Sometimes the interactive part of learning is going on in discussion groups, other courses lay stress on written materials and links, and some add audio/videoconferencing or face-to-face sessions to virtual learning. During 1998, there are approximately 20 courses to study, designed to give a worthy choice for those who want and are able to use Internet in their studies.

Expectations vs. Reality

The project was partly realized during 1997 and opened to public in January 1998, though all services were not available at that time. The whole information system is expected to be completed by the end of 1999. Like all projects, we faced a few problems realizing our goals, one being that the Web pages were designed to conform to the existing structure and way of thinking. However, it proved to be too bureaucratic for the customers, who would like a more service oriented structure. Thus, a reorganization of the content was necessary. Since the opening of the service, we have also started research and evaluation of user groups, information providers, usability and quality control. All in all, the customers have been satisfied with the provided services and our personnel has realized through daily use the value of an automated system. It has become part of our daily routine, but we are still learning and finding out new, enhanced ways of working.

One of the aims of the project was to gain experience in teaching Web-based courses, both combining different forms of study and using solely the Web. By March 1998, we had 12 courses online and 160 students in courses (70 are waiting for acceptance). Our students differ somewhat from university students, ours being mainly middle-aged people accessing our services from their workplace. We are thus contributing to our national strategy, bringing information society skills to people not reached by schools and universities.

The students have been interested in trying new forms of studying and the feedback has been mainly positive. However, the feedback is from students who have completed the courses. Thus, we do not yet know why some students have not completed the courses and what problems they face. Research is currently being conducted on this matter.

There are also concerns that virtual teaching means the same as leaving the students on their own. If we are not careful, Web courses might become too automated: Students perform on their own and in the end of the process get evaluated by the teacher. This is not the aim at all. Teacher participation is essential throughout the learning process, although the role of the teacher is not a traditional one. The teacher has to provide student support, but the problem is to know what kind of support is needed and when. That brings new challenges to teacher education, too. An important aspect of virtual teaching is also finding the best ways to use the Web to benefit the subject. Theoretic research on didactic issues in Web teaching is currently in progress.

Case Study: Basics of Computer Science - Virtual Learning Environment

One of the first pilot projects was to provide a CS basics course on the Web. Usually CS students are more technologically oriented and thus form a better audience for pilot Web courses. Since reading from the computer screen is not very convenient, the course was designed to complement a book that had been used in the course before. Updates and corrections, along with new and in-depth material, is provided on the Web. The emphasis, however, is on interactive exercises and discussion. To reduce teacher involvement, constructivist learning approach was used. Thus, students are provided with questions throughout the material which they answer on the Web. They are then asked to compare their answers to the teacher's answers, explaining the differences and why these answers are different. On a general discussion board is a collection of questions that the students can answer. The answers are public and open for comments from other students and the teacher.

All student actions are recorded in a personal folder (portfolio, learning diary), which is evaluated after the student has completed the course. The folder includes the student's reflective evaluations of study material. To reduce the workload on the teacher, participation was limited to 30 students; only upon completion of the course by a student, will another one be accepted.

So far the experiences haven't been very rewarding from the teacher's point of view. Although the students who have completed the course have given positive feedback, the students taking the course remain rather passive. The biggest problem is in timing: The students are slow to start the course and since there aren't any definitive deadlines, they're not very disciplined in progressing in their studies. In this respect, the teacher's role seems to require controlling the students progress as well as

providing feedback on their work and commenting on their answers. Effective realization of these principles proves to be a challenge requiring both revisions on the study material and changes in teacher's attitudes.

Automatic Exams and Course Administration on the Web

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Abstract

This paper describes a system that provides faculty with automatic testing and grading on-line facilities, as well as course administration resources, using the World Wide Web as a common and ubiquitous interface. The system was built using the Common Lisp HTTP Server from MIT and its functionality to generate HTML on the fly, which offers the appropriate level of interactivity and flexibility needed to design such systems. It allows instructors to create exams and to manage them on-line, and it includes automatic grading and immediate feedback to students. Also, the system allows for automated scores book-keeping: students may check their grades at any time and so may do their instructor. After presenting the system, the conclusion of this paper argues that it might be a useful framework for enhancing Web-centered education. Also, it argues that the CL-HTTP server is an ideal instrument to easily achieve this sort of interactive and automatic management.

Keywords: Web Based Training, Courseware Development, Distance Education, Server Technology, Common Lisp.

1. Introduction

This paper describes a system that aims to provide faculty with automatic testing and grading on-line facilities, as well as course administration resources, using the World Wide Web as a common and ubiquitous interface. The system was built using the *Common Lisp HTTP Server* from MIT [Mallery 1994] (http://www.ai.mit.edu/projects/iiip/doc/cl-http/home-page.html) and its functionality to generate HTML on the fly. It focuses on allowing instructors to prepare and manage on-line exams, and to manage students' grades. The World Wide Web is being used in educational environments as both a medium for unprecedented communications opportunities and information sharing across geographical limitations, and as a substrate to enhance (or to reinvent) the pedagogical process of learning [Trentin 1996], [Brusilovsky et al. 1996]. Educational applications on the Web often need some management apparatus to better achieve their goals. Specifically, this work has been focused on the design of an instructors' framework for course development over the Web. While some interesting work exists on Web-based course and exam administration [Byrnes et al. 1994], [Gibson et al. 1995], [Goldberg et al. 1996], systems in this area appear to need that some task be completed off-line by the instructor or webmaster. The basic tenet of this work, on the other hand, has been to allow full on-line access to both exam creation and management.

The system described here is in fact able to help instructors with the on-line creation of multiple on-line exams and their automatic management, including immediate feedback to students. Its goals included allowing

instructors to also access students' grades and manage course pages. While this is still work in progress, the main goals have been achieved, and a prototype system is now finished and being tested.

After presenting the system in the main sections of this paper, its conclusion will argue that this might be a useful framework to enhance Web-centered education, and that the CL-HTTP server shows to be a formidable tool for the development of advanced interactive Web pages.

The basic characteristics of the system are:

- It is server-based. It appears critical, for security and other reasons, that an exam administrator does not reside on the client.
- It maintains a global status (as a list of objects) which is saved on the server.

Each connection to the exam server (from a student's client) opens a thread, so the system can easily keep track of each student's separate exam session. On each form through which a student submits his answers there is also a hidden field to carry local status information used by CL-HTTP to avoid collisions among threads.

A student's or instructor's status is kept by parameter passing protocols and by lambda (anonymous) functions, so no cookies are used (but could be). Student and instructor data are retrieved from persistent objects after authentication.

The system was developed using the CL-HTTP Server software, a full-fledged http server implemented and *immersed* in Common Lisp and CLOS (the Common Lisp Object System). CL-HTTP offers functionalities that were considered essential for the development of the system, namely:

- It is a full http server implemented as an extension of the Lisp language, thus offering great extensibility and flexibility by means of open object-oriented programming in Lisp.
- It contains a set of language extensions useful to generate HTML code. Also, the HTML authoring operators support higher levels of abstraction than pure HTML (enumerating items, for instance.) HTML language standards are transparent.
- It allows Java and JavaScript to be integrated into Lisp code.
- It is robust, and is being used extensively in AI and education research (for instance, in the InterBook project of P. Brusilovsky [Brusilovsky et al. 1996], government (The White House Publications System), and corporate intranet development [Davies and Davies 1997];
- It is freely available (including source code) and runs on a variety of platforms.

2. The on-line Exam Creation & Management System

2.1 Description

The system's main goals are:

- To provide instructors with a simple and easy on-line interface to create and manage on-line multiple-choice and subjective exams, with such features as automatic grading, book-keeping, and feedback to students;
- To let instructors and students check grades and class' statistics, both numerically and graphically (see [Fig. 4] and [Fig. 5]).

Moreover, the former goals are part of a more comprehensive objective:

- To provide instructors with an on-line framework to help them build and manage course material based on the Web. In order to achieve this, work has still to be done to:
    - Include tools to let instructors who are inexperienced with HTML to build, publish and maintain simple courses' homepages;
    - Edit already-made exams.

In this section the system's architecture will be explained, as well as its main functions. The On-line Exam Creation & Management System starts with a Control Page that is personal to each registered instructor. In it, all courses that have been set up by the instructor are shown, together with every exam that he made available on-line. This is achieved by retrieving the system's global status, which is a list of all active courses. Each course in the list is a composite CLOS object, as shown in class taxonomy of [Fig. 1].

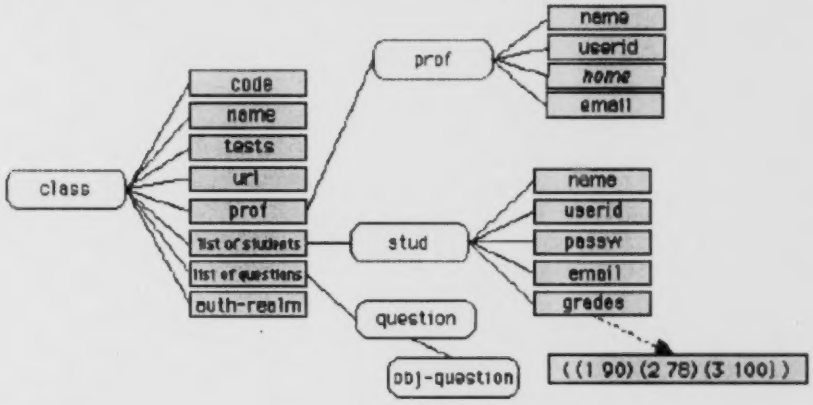

Figure 1: Class Taxonomy

In the main page the available choices are displayed by means of hyperlinks. [Fig. 2] displays the system's main page after a series of visits by an instructor. Through these links an instructor may:

- Create a new class, by defining -among other things- the students who attend the course, and assigning each of them a username and password. Sensitive data is not currently very secure, but CL-HTTP supports the MD5 digest method, so security should be easily upgraded.
- Prepare a new exam for a given course. This opens a form to enter questions (multiple-choice or subjective) and their correct answers.
- Check the exams that are already set. It opens a dynamic page which displays links towards existing exams' pages (owned by a specific instructor).
- Check or edit students' grades for a specific course. The instructor enters a course code and the server fetches her a table with students' grades and averages, built on the fly.

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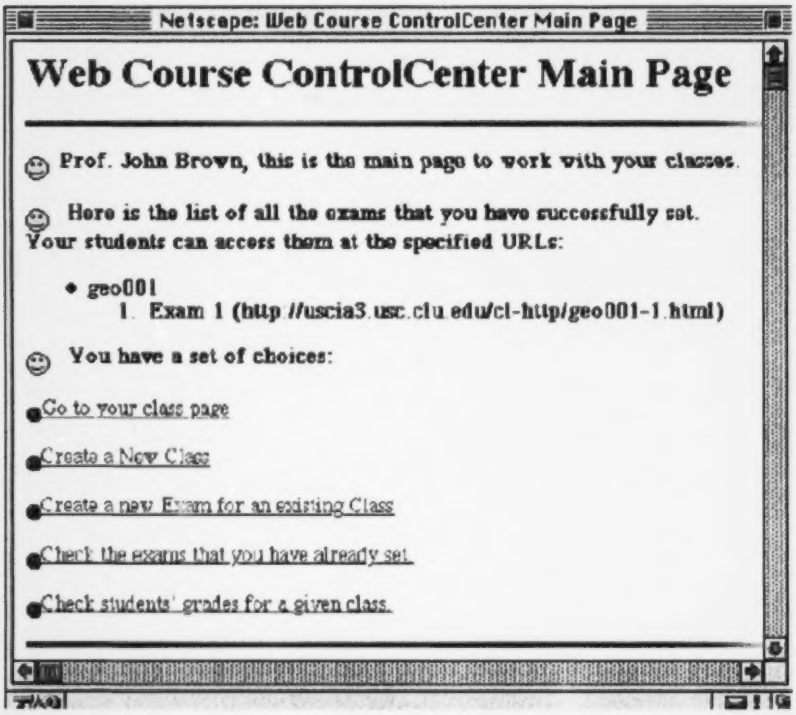
Netscape: Web Course ControlCenter Main Page
Web Course ControlCenter Main Page
Prof. John Brown, this is the main page to work with your classes.
Here is the list of all the exams that you have successfully set.
Your students can access them at the specified URLs:
• geo001
1. Exam 1 (http://uscia3.usc.clu.edu/cl-http/geo001-1.html)
You have a set of choices:
Go to your class page
Create a New Class
Create a new Exam for an existing Class
Check the exams that you have already set
Check students' grades for a given class.

Figure 2: Main Page

2.2 Design & Implementation

The system's architecture, shown in [Fig. 3] (only the first three modules are actually displayed), is modular and simple. This means that it is easy to add new modules (exam editing, for instance) and to modify existing ones. In fact, one of the advantages of the chosen server architecture and Lisp/CLOS implementation, is that several new language constructs were defined which may be used directly by a designer who wishes to add or modify something in the system.

In [Fig. 3], boxes labeled *computed url* represent pages that are computed on the fly (and that depend on user input and global status), and that are *exported* (i.e., in CL-HTTP's terminology, the server is made aware of them), with CL-HTTP's method export-url. These urls have each two functions: a *form function* to generate the form associated with the page, and a *response function* that processes the form's results. In both cases a *lambda expression* is used (an anonymous function) to define an inlined function. Through these functions, parameters are passed to the form generator and the response functions, as a means of preserving the status between form generation and response, and to let them know what class, test number and set of questions the exam refers to.

As an example, an extract of code for `respond-to-exam-main` is shown next.

```
(defmethod respond-to-exam-main ((url url:http-form) stream query-alist)
<initialization...>
;; First associate local variables to form results (in association list query-
alist)
(bind-query-values (choices CLASS-CODE TESTNUMBER OBJECTIVE
                    ANSWERS SUBJECTIVE EXPLANATION computed-choices)
                   (url query-alist)
```


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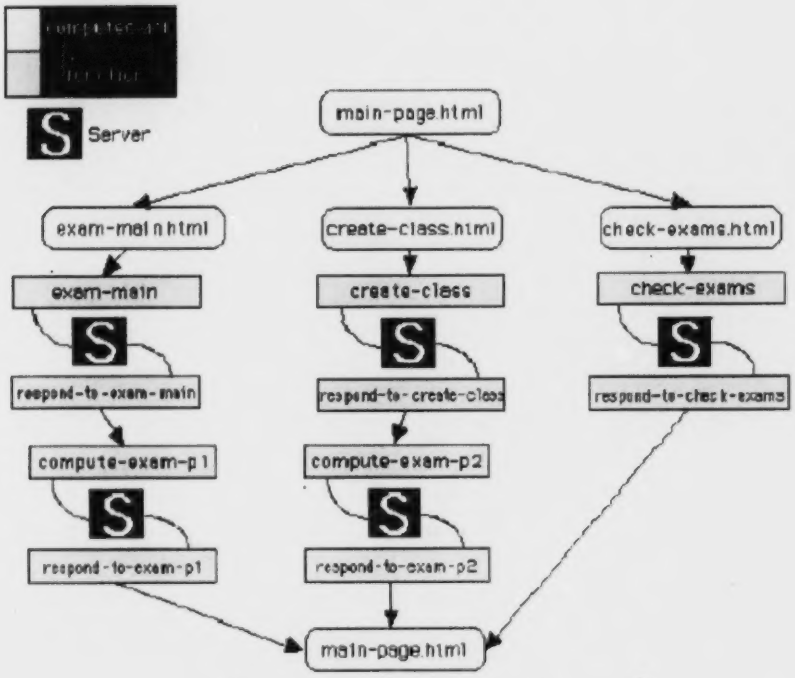

Figure 3: Exam Server's Architecture

```
;; Then get the status information.
 (let* ((real-choices choices)
        (*computed-choices*   (read-from-armor-plated-string computed-choices))
        (classcode CLASS-CODE)
        (clas (get-class classcode))
        (data (collect-data-from-query-alist query-alist)
         (user-obj (current-user-object))) ;; gets info on authent'ed user
  (update-class classcode testnumber) ;;;; SAVE UPDATED CLASS!!!
;; Then proceed to next step, by setting up a new form. The two
;; lambda expressions are used to pass status parameters.
 (http:redirect-request *server*
      (export-url #u"/cl-http/exam-step1.html"
      :html-computed-form
      :form-function #'(lambda (url stream)
                         (compute-exam-p1 url stream data user-obj))
      :expiration '(:no-expiration-header)
      :response-function #'(lambda (url stream query-alist)
             (respond-to-exam-p1 url stream query-alist data user-obj))
      :private t :language :en :keywords '(:cl-http :webnet98)
      :documentation "Exam Administration.")))))
```

After collecting the data posted by the form, getting status information on the current authenticated user, and retrieving the course object (clas, which is immediately updated with the new information regarding the exam), the former method simply forces the server to issue a redirect-request to a new page, which is defined and exported on the spot.

The new page is defined with the CL-HTTP's primitive method `export-url`, which is passed all status information via parameters `query-alist`, `data` and `user-obj`. These are fetched to the new page's form

generation and response methods `compute-exam-p1` and `respond-to-exam-p1`, respectively through two lambda functions. Similar implementation has been used for the other methods.

These modules of the system allow an instructor to create an on-line exam, which is then administered by a separate module that retrieves the questions related to it, prepares an exam HTML page, and fetches it to the student's client. When the exam is created, a new url is exported, with its form generation and response methods. When the exam is to be served, these latter methods are activated, so that the exam gets fetched to the student and then graded. Immediate feedback is given to the student (by means of a reply page with his results, and an e-mail message with the same information), and to the instructor (with an e-mail message). Also, the student object is updated with the new grade and saved. A student who already took a certain exam is not allowed to repeat it.

[Fig. 4] and [Fig. 5] show examples of grades output in text and bar graph formats.

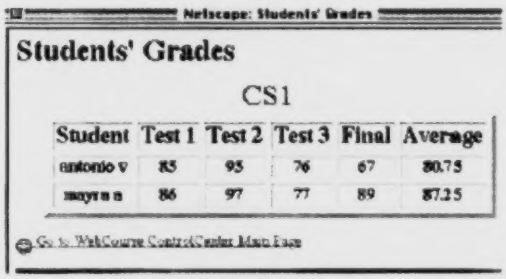
Netscape: Students' Grades
Students' Grades
CS1
Student Test 1 Test 2 Test 3 Final Average
antondo v 85 95 76 67 80.75
mayra n 86 97 77 89 87.25
Go to WebCourse Control Center Main Page

Figure 4: Course Grades

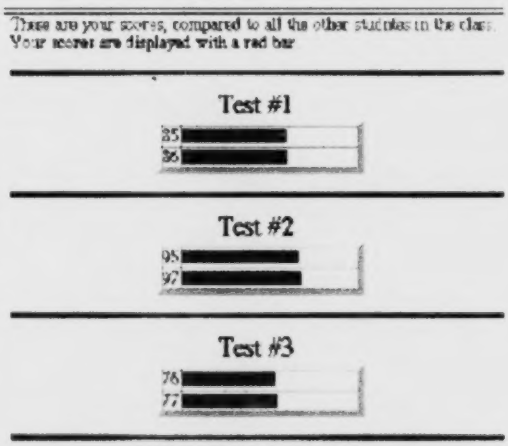

Figure 5: Scores' Bars

3. Conclusions and Future Work

In this paper two systems were presented that aim to enhance pedagogical experiences with Web-based tools. A big research effort has gone into the general theme of the World Wide Web and Education, and many researchers have produced very interesting Web systems that help enhance didactic experiences and help instructors design Web-based course contents [Goldberg et al. 1996], [Byrnes et al. 1994]. This work's aim is directed at assisting faculty in the management of on-line exams, and the book-keeping of students' evaluations, activities full of promise in both distance and traditional courses. This conclusion argues that the system is successful in that the design, tools and programming methodology all concurred to produce an effective (albeit prototypical) system, that is now being tested. Work is still needed to achieve the goal of a system fully able to support:

- Exam's questions editing;
- Instructor's design and publication of course-related Web pages.
- From the design point of view, work also needs to be done to:
- Verify the possible need to pass some computations to a client, in order to lessen the burden over the server;
- Use a more effective and efficient way to have persistent objects: A connection to an Object Database System might prove essential.

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An Intranet Solution for the Support of Administrative Operations and Research Collaboration for a University

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Abstract: This paper presents the experience and the problems solved by our implementation group, in the process of developing and integrating advanced Intranet-based services in the environment of a moderately sized University of Greece, namely University of Patras, which by now offers only basic network services (e-mail, ftp). In the following we present a short overview of the services developed, the overall system architecture, the security issues, and the critical aspects of introducing the new services to the users.

1. Introduction

The introduction of advanced network services into a university environment is today a basic need, the satisfaction of which enables the leverage of the campus administrative operations, the collaboration between different scientific groups within the university providing new means of communication and introduces the use of new teaching methodologies via the network. However, it is not an easy task since it has to overcome the traditional ways of administration, information sharing, and teaching. Moreover, it needs an effective user-oriented implementation and support mechanism in order to assure its widest acceptance and use by the academic community [Bernard 96]. Until 1997, the University of Patras only supports basic network services such as e-mail and ftp and a few servers developed within some of the University's departments, that partially support the whole campus needs, whereas services like on-line and off-line tele-training and video-conferencing only existed in an experimental level in some of the laboratories.

The basic aim of our project was to provide a set of advanced network services in the campus of Patras. The key point in this effort was to provide the whole set of services under a uniform platform, that is to integrate the services into a system using Intranet technology. Beyond the basic services (e-mail, ftp etc.) that were implemented within this project the final system integrates the following set of advanced services:

- An Intranet-based information service.
- Intranet services to support the administrative operations within the campus.
- Distance learning by means of on-line and on-line tele-training via the Web.
- Teleworking facilities.
- Videoconferencing facilities.
- Applications supporting collaborative work.

The whole system is realised through the use of the University network which is based on the TCP/IP protocol technologies enhanced by the 100Mbit speed, obtained by the fibber optic lines (FDDI) used to connect the University backbone. Two ATM switches are exploited to connect the high demand real-time applications such as video conferencing.

2. Services provided by the System

The exploitation of Intranet technologies is the base upon which the final system is developed [December 96]. The central server of the University provides a wide range of services such as:

- Information about the institution as well as general information such as announcements, festivals and other social activities in the form of multimedia rich documents.
- Links to all other departmental servers in order to reflect the current status of all the departments.
- A powerful search engine aiming to provide an easy-to-use interface for locating information based on keywords.
- Collaboration tools (such as customised USENET News or bulletin board Software) for information sharing

- Mail services with multimedia capabilities (voice mail)
- A uniform and sophisticated way of updating or inserting information, in order to give all users (professors, post-graduate or under-graduate students) the potential of information publishing

The whole system is based on third party public domain or freeware software (APACHE web server, Harvest and HtDig etc.). By using the latest programming techniques such as JAVA, JavaScript, ActiveX, VRML and WYSIWYG HTML editing, the interactive interface enables the use of multimedia in all laboratories of the University.

Another service that was developed within the project life-cycle is the implementation of several Intranets within the campus, aiming at the reduction of paper use in the administrative procedures in the University. All the traditional paper-only distributed sheets or books are stored electronically. Using text search and efficient retrieval techniques all documents are delivered on-demand to named groups of authorised persons avoiding bureaucracy.

A significant aspect that arises in this case is the protection by intruders from outside the University network or from unauthorised users. The encryption provided by the SSL 3.0 protocol is exploited to transmit information securely. Flexible user authentication controls, read/write access to individual files or directories using user name and password, domain name, host name, client-side certifications or named groups as well as the firewall technology was exploited.

Videoconferencing & Teletraining are included in the set of the advanced services provided by the final system. These services enable real-time conferencing interactions over the Intranet. Conference sessions allow the University to increase the effectiveness of workgroup, departmental, and cross-functional communication by letting users interact on the same documents, sketching on collaborative whiteboard, exchanging data files, and talking in real time with colleagues in the University [Wolfinger 91].

A customised software enables all university users to participate in Videoconferencing (on-line, off-line) sessions. Off-line Videoconferencing includes pre-recorded material such as a tutorial of classroom course. The course embellishes with pictures and/or video files to give the attendees the closest possible impression conveyed inside the classroom the actual course was given. On-line conferencing refers to the real-time transmission of audio and motion images to multiple recipients. IP Multicasting technology, in conjunction with the latest H.323 and RTP standards, is exploited to provide timely crucial data [Nicolaou 90].

A Real-audio server is installed to host all the voice announcements, extracts of important conference speeches and music or other voice material. This server provides easy voice information access to not only low-speed dial up users but to all other directly connected nodes. The compression and streaming saves precious bandwidth for other applications [Shepherd 92].

3. Conclusions

Our work showed once more that the introduction of new network services in an existing environment, even if this is a University, is not mainly a technological problem. The development of the services, their integration and introduction to the users have to follow a well defined, user oriented implementation plan.

The implementation of the Patra's University Intranet will result in money savings by offering a great potential for cost savings over existing networking and collaborative technologies, time saving since the timely implementation of a collaborative application are faster using Intranet techniques, standardization of data access: since the availability of web browsers on every major operating platform is making it possible to provide high impact graphics access to all users, regardless of their platform and finally wide area communications since web-based Intranets are ideal for developing corporate communications among geographically dispersed locations.

The final output is a pool of advanced services focused on the user needs for effective information retrieval and spreading, and the use of alternative education tools.

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Welcome to Our Neighborhood: Building a Community of Learners

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Abstract: The Department of Educational Foundations at the University of Central Florida in Orlando, Florida, has developed a new course that is required for graduation and teacher certification. Because of the large number of sections offered each semester to accommodate UCF's growing student population, the course will be taught by many different instructors, many of whom are adjuncts. In order to enhance consistency in course material, delivery of content, and communication between the large number of faculty teaching the course as well as to facilitate the incorporation of resources and activities within the course curriculum, this Web site is being developed. A chat room as well as a bulletin-board site will facilitate student-teacher and student-student communication. Faculty communication will also be enhanced by on-line and bulletin-board sites, further contributing to the building of a learning community, replete with a true sense of communication and collaboration among its members.

Welcome to the University of Central Florida's Professional Teaching Practices Faculty Web Site. The Department of Educational Foundations at the University of Central Florida in Orlando, Florida, has been charged with the development of a new course to address the needs of our beginning teacher education majors. In this class students will be exposed to the various teaching techniques involved with the presentation of materials, questioning strategies, classroom management, and the evaluation of student progress. Students will perform microteaches and will view the lessons for development of self-evaluation techniques. To acquaint the students firsthand with instructional theory, pedagogy, and the roles and responsibilities of the classroom teacher, a field experience of at least 20 hours in a local public school will be required. The course is also the forum within which the professional portfolio, a prerequisite for junior and senior internships in the University of Central Florida teacher education program, will be introduced.

As the course will be a requirement for graduation and teacher certification, there will be many sections offered each semester to accommodate the large numbers of students to be served. In addition, the University of Central Florida consists of one main campus in Orlando, Florida, and branch campuses in Volusia and Brevard Counties in Florida, all of which will offer this new course. As such, there will be numerous different instructors, including adjuncts, who will be teaching this course. In order to enhance consistency in the course material, delivery of content, and communication between the large number of Professional Teaching Practices faculty as well as to facilitate the incorporation of resources and activities within the course curriculum, this Web site is being developed.

Currently in its early stages of development, the Web site consists of several different components: Essential Course Elements, Instructional Strategies, and Resources/Assignments/Activities. The first component will consist of content such as Domains of Learning, Goals and Outcomes for Instruction, Building a Climate for Learning, Instructional Design and Strategies, The Process of Questioning, Assessing Student Achievement, and

Multiple Intelligences. Information will be linked with other sites where instructors can access specific authors, researchers, and the like associated with a particular topic.

Within the Instructional Strategies section of this Web site can be found methodologies recommended for curricular inclusion. The case study method, cooperative learning, direct teach, discovery learning, inquiry learning, simulations/games, and small group discussions are but a few of the strategies about which more detail will be accessible. These topics will be linked with corresponding researchers/educators/authors. Plans are also being made to secure videotaped teaches exemplifying different methodologies and to incorporate them within this Web site. Thus, a variety of strategies can be observed while on-line. Pairing the viewing of an actual strategy being successfully implemented with literature discussing the strategy should enhance student comprehension.

Consistency among all sections of this course in content and delivery will pose a challenge. Thus, responding to a request by new instructors to have access to course materials created by colleagues in order to facilitate their initiation into teaching a new course, the Professional Teaching Practices Faculty Web Site will also include faculty-developed materials and activities. A generic syllabus as well as black-line masters of transparencies and assessment instruments will be available. Instructors using the recommended text will be able to access chapter outlines of that text. Microteach documents such as observation paper masters, instructions, and evaluation forms will greatly facilitate the incorporation and execution of microteaches, a time-consuming but integral component of this course. A plethora of highly successful, instructor-generated activities, such as a multiple intelligences cooperative learning activity, will also be made accessible by means of this Web site. As the list of videos for this course can become quite cumbersome, a video bibliography will be included. Each video will be linked to sites dealing with its main topic, thus enhancing the depth in which material can be delivered.

Finally, in the Resources/Assignments/Activities section of the Professional Teaching Practices Faculty Web Site, a Professional Portfolio PowerPoint presentation will be incorporated. As stated previously, the professional portfolio is a requirement for admission into junior and senior internship in the teacher education program at the University of Central Florida. As such, it is imperative that education majors receive accurate and timely information regarding portfolio format and content as well as the portfolio submission and evaluation process. Currently, workshops for the approximately 600 students submitting portfolios each semester and reviewer training sessions for the 15-25 faculty members and 35-40 graduate students evaluating portfolios are scheduled each semester. However, because of scheduling conflicts, not all students can be accommodated. In addition, these workshops and reviewer sessions place a tremendous demand in reference to time and effort on those instructors conducting them. To address these concerns, a PowerPoint presentation delivering current portfolio workshop and training session content is being developed and will be accessible via the Professional Teaching Practices Faculty Web Site.

The Professional Teaching Practices Faculty Web Site at present is being viewed as a vehicle to facilitate curricular design, enhance consistency of content and its delivery, and expedite communication among faculty members. The Web site will also consist of a component that will allow faculty to communicate with one another, both on-line as well as via a bulletin-board format. In an effort to increase articulation between Professional Teaching Practices and other methods/strategies courses within the College of Education, all faculty will be encouraged to peruse the Web site to familiarize themselves with the course content. It is hoped that increased course awareness will result in curricular modifications throughout the College in order to maximize the range of information, experiences, activities to which our students are exposed.

Although the Web site was initially conceived for faculty use, another component will eventually be a student Web page to encourage student-student and student-teacher interaction. Students will be able to access information dealing with the individual instructors of the course. In an effort to personalize the course, photographs, syllabi, office hours, and other pertinent information regarding each Professional Teaching Practices instructor will be available. A chat room in which students may converse with each other on-line as well as a bulletin-board site where they may leave messages will also be developed. Also planned for design is a continually-updated list of articles to which students may refer for additional information on special interest topics.

Our neighborhood is rapidly rising from its solid foundation. However, the original plans continue to undergo revision as the structure begins to take shape because of the seemingly endless possibilities. Regardless of the numerous modifications made to the Web site as it undergoes construction, our ultimate goal remains unaltered: to create a learning community, replete with a true sense of communication and collaboration among its members.

Improving Instructional Quality and Coherence in a Multi-Section General Music Course: The Music 103 Course Web Page http://www.olemiss.edu/~rvernon/mus103

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In the spring of 1998, the students taking a music service course at the University of Mississippi became the beneficiaries of a creative use of the local campus web, an all-too-rare occurrence in arts instruction. A web-based resource provided increased consistency among multiple sections of the same class, a centralized source of information, and an on-line review for each major unit.

Now celebrating its sesquicentennial year, the University of Mississippi has been listed as a Yahoo AMost-Wired Campus.@ Network connections for every residence hall resident, every office, laboratory, and classroom have been available for about two years. The faculty is encouraged to incorporate technology into their classes and a Faculty Technology Development Center was established about four years ago to assist the faculty in this endeavor. Course web pages have become increasingly common, but most of them reproduce content previously available in printed form. Because the extensive campus network makes it easier for students to have reliable access to information on the campus web server, a centralized course web page was conceived to provide a common experience for students in multiple sections of the same course with different instructors and to enhance course content and pedagogy.

Music 103 is a one-semester survey course designed to offer an introduction to the elements and structure of music, a survey of Western art music, and an initial exposure to a sample of World Music traditions. The course corresponds to the AMusic Appreciation@ course offered in colleges and universities throughout the country. The University of Mississippi offers eleven sections of this course each semester, including one section restricted to students in the McDonnell-Barksdale Honors College. The average class size is 45. Student demand for the course is high. It is the most commonly selected course for satisfying a Fine Arts general education requirement in the College of Liberal Arts and the various professional schools at the University. Most of the instructors for the course are doctoral students or part-time instructors, although senior faculty occasionally teach a section. In August, 1997, one faculty member was designated to coordinate and unify the multiple sections and to teach the Honors section.

Several challenges in the course design and practice were identified:

- The course had a reputation of limited intellectual vigor and rigor.
- The instructors assigned to the course often had no experience teaching music literature.
- The instructional philosophy and course objectives were not clearly articulated.
- Content and instructional practice were inconsistent in the sections, in spite of a uniform text adoption.
- No strong support, supervision, or development program had been established for the graduate student instructors.

Several features were implemented for the 1997 Fall Semester to address these concerns:

- A handbook of administrative practices and procedures.
- A week-long teacher preparation institute, including presentations on course content by music faculty members, on student writing by the Director of the University Writing Center, and on teaching and testing practices by professors recognized for teaching excellence.
- A weekly instructor seminar throughout the academic year.
- A common course syllabus and calendar.
- A systematic schedule of class observation, examination review, and instructor consultation.
- *A single course web page, used by students in all sections*

These innovations were designed to create a livelier course for undergraduates, and to enhance the professional preparation of our doctoral students, most of whom aspire to careers in higher education. The goal was to create a course with consistent content, expectations, and educational philosophy while preserving instructor creativity and genuine classroom interchange. Early evidence indicates that they have affected instructor performance and morale and student performance. The use of instructional technology in the design of the course web page has been an important element in achieving all the course goals.

The web page for Music 103 includes a variety of features for the student. These include a brief description of the course for prospective students, the syllabus, the course and examination schedule, some suggestions for study practices, and a calendar of recitals and concerts. All these features are on-line versions of materials that have been traditionally distributed to students as printed documents. A small advantage to the on-line recital calendar is that it can be revised as needed without the trouble and expense of preparing about six hundred paper copies. The materials were developed collaboratively at the end of the training institute, and are revised each semester as improvements are identified.

A feature on the Music 103 web page which had not been previously available to students in the course is a set of outlines for each major unit. These outlines were initially developed by the course supervisor for establishing course priorities, and were later collaboratively revised for use by all the instructors. Distribution of printed copies to students is impractical because of the large enrollment in the course. A guiding principle of instruction in Music 103 is to give the students as much information as possible about the course content and structure. The World Wide Web allows a far greater access to such information than would otherwise be feasible. An additional feature of the course web page is a listing of useful links. Although a student can complete the course successfully without using the World Wide Web, there are many WWW sites that provide useful supplementary or complementary information. Many of our students enjoy using web-based material, and find this feature helpful and pleasant.

The most distinctive feature of the Music 103 web page is the on-line review. This feature was developed to address several concerns about instruction and student performance in the course. Exam reviews are an established practice in many college and university courses. They usually take place either during the class meeting immediately before an exam, or at a specially designated time. Both of these practices have difficulties associated with them. A review session during a regularly scheduled class period means a loss of instructional time. A teacher must compensate either by deleting material from the course, or teaching more superficially. Reviews at specially scheduled times make additional demands on instructor time, and inevitably create schedule conflicts for some students. Graduate and part-time instructors are already under significant time pressures. Either type of scheduled review is necessarily limited in duration, and may not meet the individual needs of each student. A well-constructed on-line review increases accessibility, avoids scheduling problems, and preserves class time for teaching.

The review is organized by each major unit in the course. At the end of the semester, students have the option of reviewing the entire database at once. The file has a limit of about fifty questions per unit. There are ten units, allowing an ultimate question menu of approximately five hundred items, which is adequate for a thorough review of all major topics. The material to be included in the review originates in the weekly instructors= seminars. Topics which present particular challenges to students are identified, and teaching strategies are discussed. The questions are suggested as a part of the teaching strategy. Questions and answers in a multiple-choice or true-false form are developed by the supervisor. A notable aspect of the review is the extensive response given to each answer, whether a correct or incorrect choice is made. The purpose of the review is not only to allow the students to evaluate their mastery of the material, but to provide the kind of coaching experience normally available during a traditional review session. Questions currently incorporate both text and image content, and audio questions will be included when copyright issues for the recordings can be clarified. The quiz section of the web site was developed using standard HTML tags. To make the site accessible to as many browsers as possible, neither JavaScript nor VBScript was used. Frames were used to keep both each question and its responses on display: within a larger frame, there are individual frames for the question and its possible answers. Anyone with a frames-capable browser who wishes to adapt this on-line review feature can access its code.

Besides creating an extensive learning resource, the development of the on-line review has required the teaching staff to consider matters of course vocabulary, emphasis, and strategy more carefully than before. An increased sense of collegiality and common purpose among the instructors has been one of the most exciting results of this project.

Evaluation of Computer-Assisted Assignments in a Networking Courseware

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Abstract

We describe the work-in-progress project of a software tool to implement and evaluate a computer-assisted personalized approach for homework assignments using the world wide web, evaluation tests of the students' knowledge background, and examinations, currently used in a computer networks course, used for the first time at the University of the Balearic Islands. Due to the university's geographical environment (it covers three different islands), we have a specially appropriate testbed in the field of the application of information technologies to undergarduate education and, in particular, the computer-assisted learning. This short paper describes the first results about the student's rating of the system and performance.

Key-words: distance education, educational multimedia, computer-assisted learning

1 Introduction

The University of the Balearic Islands (UIB) has continued in the recent years to extend and broaden its efforts in the revitalization of the undergraduate education. The project described in this short paper is one of the last initiatives of a whole project, and the work-in-progress is summarized.

It's well-known that students can learn better when they are stimulated by the courseware interactivity and they can follow a personal way to learn. Indeed, some courseware prototypes for the specific field of networking learning have been reported with high interactivity with good results [9]. Two are the main parts of our courseware:

(A) the course's specific material web pages which includes also URL links to related items, links to a lot of solved exercises and problems, links to homework problems, and links to experience questionnaires and knowledge tests, and

(B) a forum of discussion with advanced features, which virtually gives the course as an electronic community. Electronic communities are useful to link geographically-dispersed people, which is a potential field of application in our islands. Nevertheless, as reported in the literature, there are key factors for success in such electronic groups: (1) that the group have a purpose and specific outcome; (2) that at least one person in the group acts as a facilitator; (3) that there is purpose and good reason for convening the group electronically.

Concerning to (A), many web-based courses on networking, with similar instructional material and contents, can be found on the web. But what we want to emphasize in this paper, and it is a fundamental goal of the project, is our interest to study the impact produced on the learning process by the synergy of using the potentialities of a forum in conjunction with conventional material.

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2 General Features of our Approach

Incorporating software engineering methodologies is a critical aspect [5],[7] we are in mind. Also, as computer-science professionals we are leading the project because it is difficult for educators that lack technical background to create sophisticated www -based courses [6]. In particular, the term computer-mediated communications [2] includes, in our context, tools such a web server, video conferencing facilities, and a set of wireless area network (WLAN) devices that allow to access to teacher's lectures and all educational material at the network-wired web, and to the forum, from the classroom, using only a laptop with a wireless device attached with a PCMCIA card, and a portable video projector.

One important limit is the need not to overload the students: questionnaires and interviews in order to learn more have the students limited tolerance for this addition to their time. So that we have kept a compromise between the amount of feedback and the implications of such quizzes on the student performance. The most important criterion in testing is whether the courseware is effective in the sense that students learns from it.

About the task experience questionnaire. Targeting particular skills concerning the background knowledge of the students, it has been useful for us, the teachers, to have some information about the students' previous and current experience in the domain of computer networks. The questionnaires have taken the format of an anonymous test with about fifty rather-basic questions to be selected among four possible answers. The anonymity oh the test was because students were reluctant to reveal their identify, worried about the test's implication on its final grade. Anonymity was guaranteed because this kind of test did not have any grade's implication and was completely different to, and should not be confused with, diagnostic tests to establish individual learning needs, that is the knowledge quizzes.

About knowledge quizzes: the quizzes are constructed similarly to the task experience questionnaire. For consistent marking, the quiz is multiple choice: students should select the correct answer among (usually) four. Two basic kinds of questions were posed which implies: a) the computation of a result and the selection of the suitable answer, and b) the selection of a statement on the basis on the truthfulness or the falseness suggested by the question. The consistency of a question, in the sense that it will be completely understood by the student, has two main implications to be carefully taken into account by the teacher: (a) has no ambiguities, i.e.,. only one is truth or false, depending on the nature of the question, and (b) in the questions with computations, the accuracy of the results has a reasonable degree of tolerance; in other words, and the suggested answers are posed on the basis of either with different order-of-magnitude or with enough numeric 'distancing'.

Each question usually corresponds to a distinct learning objective. The courseware's teachers interface gives automatically the possibility to enter: i) the number of questions of the particular quiz, ii) the text of each question directly or from a questions' database, and iii) the number of suggested answers, one and only one of each is correct, and the corresponding text.

3 Feedback for the Instructors

The large body of literature that exists concerning the design and evaluation of instruction and training systems, and that were though using different distance learning technologies [4]. The three issues addressed, which we are taking into account in our project to evaluate its effectiveness are:

(1) Was the course a success in terms of academic performance and proficiency gains?
(2) Was it successful in terms of student satisfaction?, and
(3) Did the technology support a high level of student interactivity?

The first issue is a virtual standard for evaluating instructional programs; the second issue one may be critical to increase student motivation and to improve its learning. Seven parameters are reported in the literature, to be taken into account in our context to compute the student satisfaction with the: (a) instructor(s); (b) technology (c) course management (d) at-site personnel (d) promptness of material delivery relative to timing of the lectures (e) support services; and (f) out-of-class interaction with instructor(s).

The third issue is, namely, relevant to: (i) the real-time availability of the web server (ii) the student's accessibility to personal computers at the university and/or at home, and (iii) the ergonomics, in the sense of he student's feeling of how easily the courseware interface with the course's material is. About (i) the server is has not already get a 100% of availability due to maintenance tasks, but it will. As far as concerns to (ii), about 180 personal computers are available to students at different sites of the campus. Concerning the point (iii), our efforts are, by the one hand, to use an interface as ergonomic as possible, interacting with students suggestions and, on the other, using an electronic tool for electronic groups.

As far as we have already get some practical experience, each of these factors have a very clear impact in our context. For the forum, the used tool for electronic groups is the AltaVista Forum [8] o create a group or "team" of course's members (students, teachers, and at-site supporting personnel). This application provides a fun and easy way to communicate and to share resources with different groups of people. It means that a student can belong to as many teams (courses) as he is registered: with the forum, he is viewing his own student profile and enters the specific course by clicking on among the list of courses. By now, only the computer networks advanced course is on line, but it's likely expected to be other very different courses during the next academic year 98-99, as experience is gained with our work. Other features make the forum tool very attractive for the computed-assisted learning: every course member can communicate with other people, individually or in a broadcast or multicast form, by posting notes in an on-line conversation, by requesting an appointment with another member of the forum, by having the tool notify members through electronic mail when new information has been added to the forum, and by having on-line conferences in the form of real-time chatting. In addition to this virtual communication channel members can share resources with other by sharing documents, by keeping a course calendar of meetings and events, and by searching Interment news sources and sharing those with others. This is useful both for teachers to get in contact with specific students or to notify the addition of new materials, proposals of dates for new quizzes, etc. and for students to get in contact both with teachers and other students. The forum tool lets members operate in an environment where there is a high level of trust, and because of the number of students of the computer networks course is relatively small (about fourteen), that trust is effectively possible. Nevertheless, teachers and other support-persons have some privileges: they

are able to add or delete members, add and delete each other's documents and discussion notes .

4 Student Performance

In order to analyze the student performance, following partially the method suggested in [3], we are observing the following parameters:

1. The distribution of the solved homework problems in % for the whole class.
2. The average performance in the final exam, in %, as a function of the fraction of homework problems solved, in %.
3. The correlation between the percentage of solved homework problems to percentage correct on the final exam.
4. The total number of logins as a function of time during the course. In particular to observe its correlation with deadlines of homework, test and exams.
5. The average number of solved problems, in %, compared with the actual degree of difficulty, not the *a-priori* difficulty estimated by the teachers, defined by the ratio of number of wrong answers over the number of total answers, for the different homework sets.
6. The degree of difficulty, expressed as the ratio of number of wrong answers over the number of total answers for all of the individual problems (of all homework sets).

5 Concluding Remarks

The term 'evaluation' implies making a judgment; a better statement is "to discover how an educational intervention performs by observing and measuring the teaching and learning process, or some small slice of it [1]. By now, as far as the experience is still new at our university and the course has not finished, no too much information is still available to get reliable conclusions. In the near future, more courses will probably adopt our approach and use our experience, so more refined conclusions are expected to be available and be reported in future papers.

Nevertheless, we have observed that one of the main conclusions found in the literature [1] is applicable to our experience, which is that the main benefit of computer-aided learning is to help teachers make better use of it by adjusting how it is used, rather than by changing the software or informing purchasing decisions.

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Perceptions of On-line Shopping and Catalog Shopping[1]

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Abstract: The purpose of this paper is to give an overview of one study that is part of an ongoing research effort that investigates consumers' attitudes-toward-Internet-catalog-shopping. These studies examine differences in perceptions of on-line catalog shopping via the Internet and more traditional print catalog shopping of ordering merchandise by mail or telephone. Preliminary results from the present study suggest that there are significant differences in perceptions of on-line catalog shopping and print catalog shopping, and perceptions differ by two important factors: individual differences in personality and impact of relevant other people.

1. Introduction

On-line shopping via the Internet has enormous commercial possibilities; but the Internet is a new and dynamic medium that poses special challenges for marketers [Reynolds 1997]. In order to assist marketers, it is critical to understand consumers' perceptions of on-line shopping. Two factors that might play important roles on cyber consumer behavior and in-home shopping decisions are individual differences in personality and influence of important other people.

Research by [Haugtvedt & Petty 1992] and others [Claxton & McIntyre 1994] on personality focuses on differences in "need-for-cognition" (i.e., whether higher and lower need-for-cognition individuals differ in processing product-related information and peripheral cues). Previous research has suggested certain individuals may pay more attention to product specific cues than other individuals, or some individuals may be more distracted by non-product cues, such as attractive endorsers and displays, than others. [Haugtvedt & Petty 1992] indicated that higher need-for-cognition individuals are more likely to process product-relevant information and put more effort into developing reasons for liking products than lower need-for-cognition individuals. [Inman et al. 1990] found that higher need-for-cognition individuals use more complex decision-making rules and process product-related information more carefully than lower need-for-cognition individuals. Since the Internet offers the capability to conduct exhaustive searches for detailed product information, it is expected that higher need-for-cognition individuals would have more favorable attitudes toward Internet shopping (i.e., they can quickly find product information and make brand comparisons) than lower need-for-cognition individuals.

Over two decades ago, [Fishbein & Ajzen 1975] examined the impact of important other people (i.e., their relevance, power and perceived opinions) on individuals' attitudes and behavioral intentions. Some of their findings, along with findings from related studies [Darden & Dorsch 1990] suggested that most individuals are susceptible to the influence of other people. Recently, [Evans et al. 1996] substantiated these earlier findings in investigations of individuals' retail-store-patronage-intentions. Although most consumer shopping via the Internet is conducted at home and without witnesses (i.e., without individuals having to worry about what others might think), it is believed that important others' perceived opinions might influence younger individuals' attitudes-toward-Internet-shopping. That is, in an innovator-imitator framework, younger individuals might attempt to "fit-in" with perceived opinions of older important others.

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[1] An unabridged version of this paper will be available in a forthcoming issue of the *Journal of Internet Research* [Jones & Vijayasarathy 1998]

2. Preliminary Results and Discussion

Preliminary findings from controlled experiments using undergraduate students as subjects suggest that individuals' have unfavorable perceptions of Internet shopping security in comparison to traditional catalog shopping. That is, consumers are wary about giving credit card numbers over the Internet. In addition, they question the legitimacy of some Internet businesses. To change perceptions of poor Internet security, electronic retailers need to secure their Web servers and then promote the safety and legitimacy of their businesses to target markets.

Other findings indicate that personality differences in individuals affect the way they react to content and presentation of product information. Electronic retailers might try to develop different campaigns that target different personality types. For example, electronic retailers might appeal to individuals who put a lot of effort in reading product information by using links that provide additional information on desired products or related links to complementary products. In addition, the interactive nature of electronic retailing offers the flexibility to customize the shopping experience. Electronic retailers might build personality profiles of individuals by asking them to respond to a few key questions. These profiles can be used to match different individuals to appropriate catalog designs.

Finally, some findings indicate that there is little, or no, consistency between individuals' opinions of on-line shopping and important others' perceived opinions of on-line shopping. The individuals in the present study have more favorable opinions toward on-line shopping than important others. Electronic retailers might try to develop promotion campaigns targeting certain individuals and emphasizing certain shopping-mode images, such as, convenience, selection, hyper-information, transaction simplicity, and delivery expedience.

3. Conclusion

Although there is considerable optimism for the future of Internet Commerce, there is also a paucity of empirical findings. Since there is almost limitless potential to customize electronic storefronts, a key avenue of research is the exploration of individual differences in the context of on-line shopping perceptions and behavior. Results of these studies should light on the formulation of strategies to attract and retain customers in an increasingly crowded, fragmented, and complex cyber market.

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SYSTEMWIDE TECHNLOGY: STAFF DEVELOPMENT THROUGH A TURNKEY TRAINER MODEL

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Abstract: Using a PowerPoint presentation, the Associate Superintendent, a fifth grade teacher and a high school English teacher will demonstrate the key ideas and themes of the staff development Turnkey Trainer Model and its applications and benefits within the school district. The Associate Superintendent will discuss the "administrative" role of the model (*budget, implementation of the turnkey trainers—choosing the "Teacher Technologists"*). The two Turnkey Trainer Representatives (one elementary, one secondary) will present the ***trainers in action.*** They will explain how the staff development sessions are conducted; how encouraging reluctant staff builds trust and willingness to try and learn; how continuous support and growth enable cooperation among faculty, as well as between buildings. All presenters will discuss obstacles, challenges and strengths of implementing technology into a school district. The discussion will be supported with handouts of successful staff development workshops. A question and answer period will follow the presentation.

DESCRIPTION

Continuous training has been the key to keeping up with the advancements and changes with technology in the education field, especially with the inclusion of the Internet in many of the new learning standards. The needs of the teachers must be met if a district wants to successfully implement the use of technology. The Turnkey Trainer model, which supports the technologies and has continual training, can only lead to successful teaching and learning in the classroom. Staff development can make a powerful difference for students and teachers alike. Although districts may have different demographics, the problems facing districts, in regard to staff development and technology, remain the same. Effective teaching with technology can only be accomplished if districts devote money, time and opportunities for further training of the staff.

OBJECTIVES

The presentation will provide an overview of a staff development model that supported a district wide implementation of technology in our school system. Turnkey Trainer Representatives (**K-12**) and the Associate Superintendent for Personnel and Technology will explain the model. Issues such as*: linkage to curriculum, budget, and variance in teacher technology skills* will be addressed. Other issues that will be discussed are: how staff development activities, in-service programs and summer technology academies increased the skills and use of technology in the classroom by integrating the technology, in particular the Internet and intranets, as tools into lessons.

ACKNOWLEDGEMENTS

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The On-Line Survey System for Distance Learning Education At the University of Central Florida

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Abstract: On-line survey system is an information discover system developed by the University of Central Florida. With the system the survey questionnaire can be placed on the World Wide Web and survey participants can complete the survey questionnaire on-line. When each survey participant complete his questionnaire, a data file will send electronically to the survey data center in predefined data format and ready to be analyzed. The data collected then transfer to a data analysis system to obtain factual information to support decision-maker to measure attitudes and to evaluate services and programs. This survey system is especially useful when similar survey needs to be conducted in several locations and needs to be repeated many times. The data analysis system can combine factual information obtained in several locations and time periods with meta-analysis technique.

1. Introduction:

Questionnaire survey is an effective technique to collect data. The data collected in a questionnaire survey can be used to obtain factual and demographic information, to measure attitudes, to evaluate products, services, and programs. Usually, these valuable information are hidden in data and need to be discovered. The data collected in questionnaire survey can be used to discover information only if they are in a form ready to be analyzed by the data analysis system. However, the data collected in traditional survey systems such as telephone survey and paper survey need to take a very long time to transfer to this form. Moreover, this transformation process is labor intensive and human errors associated with data entries are inevitable. Consequently, the quality of the data and the information is reduced significantly. Although on-line survey system uses the World Wide Web as a media to put the survey questionnaire, it is not just put the survey questionnaire on the World Wide Web. Four logical components make up this system -- an questionnaire design and data extract tool, a set of data analysis tools, several networks of computers, and several databases.

2. Distance Learning Education in University of Central Florida:

Three delivery modes for distance learning education -- videotape mode, interactive television mode, and asynchronous learning network (ALN) mode, have been used at the University of Central Florida. Asynchronous learning network based on the World Wide Web is a relatively new deliver mode. This newly developed learning mode has attracted considerable attention because this learning mode can be accessed by anyone, anywhere, anytime. Two different types of courses, web-based courses and media-enhanced courses, are offered through ALN mode with the World Wide Web as the primary delivery mechanism. Students' enrollment in these two types of courses has increased dramatically (see Figure 1) since Fall semester of 1997. There are fifty-five web-based and media-enhanced courses offered and fifty such courses are under development in the Spring semester of 1998. About a third of these courses are web-based courses that are delivered fully on-line with minimum class meetings for examination purpose. The remaining courses are web-enhanced courses with a one-hour (instead of three-hours) classroom meeting each week. Several research projects had been conducted to determine the effectiveness of distance instruction with ALN mode and all of these studies led to the conclusion that ALN mode based on the World Wide Web is the promising distance learning education mode of 21st century.

Although distance learning based on the World Wide Web is the method of choice, there are many problems to be addressed to make this delivery system more appealing. First, the courses offered through the World Wide Web depend heavily on electronic assignments, quizzes, and examinations. This raises the question on how to comply with the accreditation standards set forth by the Southern Association of Colleges and Schools. Second, most of the web-based and media-enhanced courses are created with the intention to increase interaction in large classes, to improve retention, and to increase productivity. These intentions must be accessed. Third, the learning effectiveness under the World Wide Web environment compared with traditional learning environment has to study. Fourth, many state of the arts tools such as WebCT, Cyberprof, Novell Group Wise, WebEdit, MS Office 97, Adobe Photoshop, MS Frontpage, Netscape Communicator, Macromedia, Authorware are used to deliver courses on the World Wide Web. These tools are new and how to utilize these tools to enhance distance learning is still under experimentation. Fifth, the potential impact of distance learning education based on the World Wide Web is still under investigation. Many research projects have been conducted to search the answers for these problems. These research projects depend heavily on questionnaire survey to collect data. An on-line survey system is a natural choice if an on-line survey system is in order. An on-line survey system can provide dependable, reliable, and efficient information to administrators, instructors, course development team, and researchers the solutions to the above problems in a timely manner. Since there is not any commercial on-line survey system available, the University of Central Florida decides to pioneer the development of such a system.

3. Logical structure of the On-Line Survey System:

The on-line survey system for distance learning education used in University of Central Florida is part of the university wide net work. It has four logical components: an questionnaire design and data extract tool, a set of statistical analysis tools, several network of computers, and several databases. The questionnaire design and data extract tool serves as a bridge that connects the other three components to form a knowledge discovery system. Statistical analysis tools are used to transfer data into information. Currently, there are three identified information items. The first information item contains and displays descriptive statistics generated from the data in the form of graphs, reports, charts, maps, and summary tables. The primary users of this information item are administrators. The second information item contains and displays inferential statistics generated from the data in the form of hypothesis testing, trending analysis, geographical system, and prediction models. The primary users of this information item are faculty and researchers. The third information item contains meta data tables. The primary users of this information item are course development team and IT (information technology) personnel. Two main severs, course development sever (reach.ucf.edu) and e-mail sever (pegasus.cc.ucf.edu), and several local area network of personnel computers and workstations form the logical components of computer network. The data component contains two main operational databases, ORACLE and SHADOW, and several ODBC (Open Data Base Connectivity) compatible databases such as dBase and ACCESS that are used by faculty.

The main engine of this system is the questionnaire design and data extract tool developed by the Course Development Team of the University of Central Florida. This questionnaire design and data extract tool have the following capabilities:

- To put the survey questionnaire on-line
- To extract data from survey questionnaire automatically
- To access through both Internet and intranet easily
- To support multiple platforms and multiple operating systems
- User friendly

4. Strength of On-Line Survey System:

On-line surveys have all of the strengths and few of the weaknesses of paper and telephone surveys. A few of these strengths are noted below.

- On-line surveys can be used to study the geographical differences because there are no geographical restrictions in on-line survey. For example, one can study geographical differences in alcohol consumption based on legal age of drinking, state liquor excise tax rates, and other demographic information.
- On-line surveys can be used to study data trends over time. Although the set up cost of on-line survey is higher than with a regular survey, the operation cost of on-line survey is relative low. Thus, we can continue on-line survey on semester basis and discover the time trends of distance education in an efficient manner.
- In on-line surveys one can randomly assign participants to different experimental conditions. Thus, one can conduct experimental studies rather than just correlational studies.
- One can randomize and counterbalance the presentation order of different items in an on-line survey, thereby strengthening the methodological quality of the study.

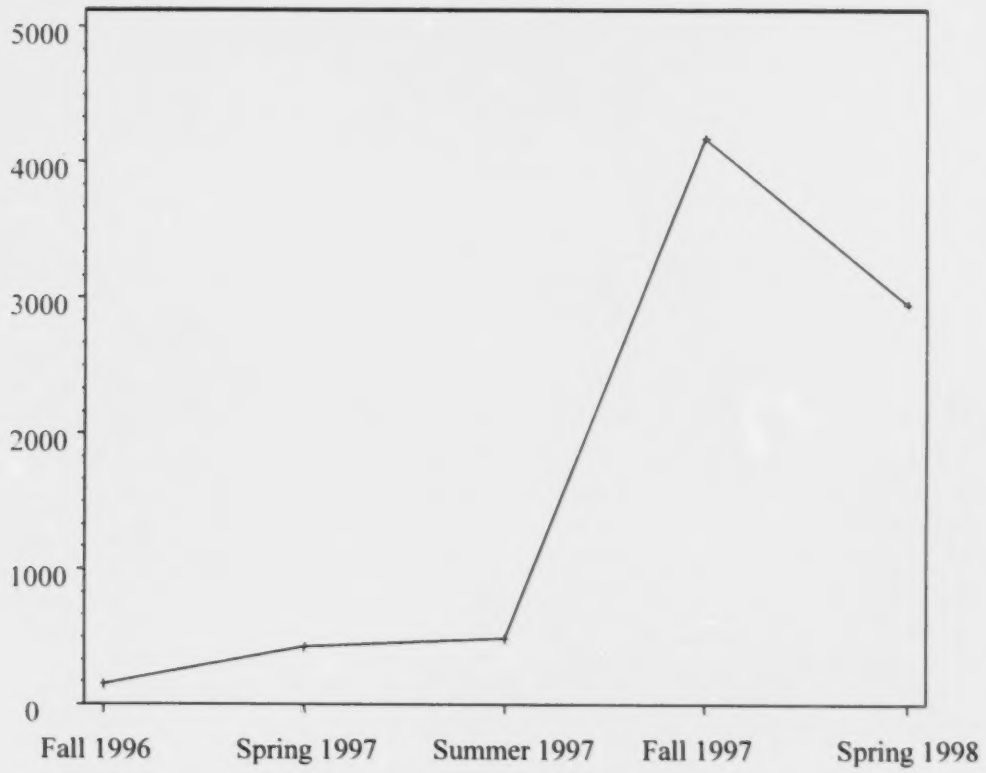
5. Potential Benefits to Distance Learning Education at the University of Central Florida:

The University of Central Florida has been very successful in distance learning education through the World Wide Web. Many different courses have been offered in the past two years. Numerous data have been collected to assess the effectiveness of distance learning education. The huge collection of data can be used to answer problems related to the distance learning education. There are many potential benefits to the University of Central and the distance learning community at large. Some of these potential benefits are:

- administrators, faculty, course development team, and IT personnel can access information items in a real time basis;
- information items presented are carefully studied and organized in advance;
- information reliability is obtained with integrated, consistent, and quality assured data;
- trending analysis and impact analysis for the distance learning education can be achieved with objective analysis based on data;
- offering data to interested faculty to conduct research projects related to distance learning education.

Figure 1 Growth of On-Line Courses at UCF (1996 to 1998)

Number of Students



INTERNATIONAL TECHNOLOGY TRANSFERS
- a Telebased Distance Learning Programme

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Background

For more than fifteen years social science courses on international technology transfers have been offered to engineering students at the Technical University of Denmark. The courses have drawn upon the long tradition developed by Danish engineering companies for working in projects outside Denmark. Today, Danish consultancy firms win more contracts for engineering services than their competitors.

The experiences from these conventional courses can now form the basis for a development of new course materials designed as a telebased distance learning programme to be offered through the Internet as an in-service training for engineers.

The internationalization of European companies implies that new operations are established in countries, in which the cultural, social and political setting are often quite different from those of the home company. In particular, this applies to expansion in new, emerging markets, e.g. in Southeast Asia. This process of restructuring requires engineers, who are highly skilled in the solving of problems associated with international technology transfers. They must be well prepared to work in those interdisciplinary project teams, which typically plan and start these transfers trying to secure their successful rooting in the host country.

A number of research projects in Scandinavia have documented that currently the preparation for international technology transfers by private companies is most often based upon the individual communication of experiences attached to particular persons. This implies a rather unsystematic practice, by which a continuous accumulation and analysis of knowledge do not occur. In Denmark, surveys conducted by the Danish Association of Engineers show that almost every Danish engineer becomes involved in projects outside the country. The Association has on several occasions documented the need for more training in skills on international technology transfers and has suggested specific changes of curriculums at institutions of higher learning. The project will develop a course offering which is easily available to engineers and engineering students in any country as well as a forum for theme-based, continuous exchange and discussion of practical experiences.

Objectives

1. to develop an in-service training course conducted as a telebased distance learning programme for engineers employed at projects involving international technology transfers out of the home country and for other professionals working in such projects.

2. to create a tele-based teaching and tuition system for engineering students at the Technical University of Denmark, who choose to carry out individual assignments, including final-year projects and Ph.D. projects, which involves an extended period of field study overseas.

3. to create a tele-based system of interaction within the activities 1) and 2) between on the one hand the course teacher's communication of theoretical texts and methods, and on the other hand practical experiences of the course participants in terms of gathering case examples and conducting thematic discussion sessions in such ways that the professional contents of both activities are continuously improved and updated.

Target groups

1. Engineers who are in service in relation to international technology transfers, and other professionals who are involved in this area or in international development cooperation, as well as the companies, by which the engineers are employed.

2. Engineering students at the Technical University of Denmark, and students of tertiary educational institutions within the same or related fields.

Funding

The project has received a grant of DKr. 900.000 from the Centre of Technology-Assisted Education, the Danish Ministry of Education, and is in process of applying for additional funds.

Project organization

Two research teams are formed at Department of Technology and Social Sciences and Department of Teleinformation respectively. The team at the Department of Technology and Social Sciences is responsible for the development of the contents and pedagogical method in the in-service training and the tuition during field studies. The team at the Department of Teleinformation has an advisory rôle in the development of these activities as teleapplications. Through the participation in courses and conferences the internal competence of the project on teleapplications is strengthened; an external network is formed to secure a continuous updating with regard to current standards and methodologies of teleapplications.

Project activities

The project establishes two types of telebased learning activities and builds into these a third telebased method for interactive, two-way communication between the teacher and students.

The first is an in-service training course, which is targeted at engineers working with international technology transfers out of the home country during a longer period. The individual communication of experiences attached to particular persons, which currently exists as a relatively unsystematic practice within engineering consultancy firms, can be supplemented by a scientifically based presentation of theories, methods and examples through this project. At the same time, the in-service training programme offers a more detailed, cumulative and a continuous supplement to the accumulation of experiences taking place within the associations of the engineering profession through ad hoc written summaries.

The second activity is a teaching and tuition system for engineering students, who as part of their education, most often the final part, conduct field studies on international technology transfers during a longer period. A telebased activity will make it possible to maintain contact between the teacher and students during this decisive period of completing a field assignment. At the same time, the student will be able easily to access relevant knowledge resources and dialogue opportunities.

The third and genuinely innovative component concerns the creation of telebased systems within each of the two activities mentioned above to communicate immediate feedback and learning processes across geographical distances. In particular, in relation to the in-service training programme practical experiences and knowledge of the participants, which earlier were attached to individual persons, undocumented and very difficult to locate, can now be made available. For the students doing fieldwork this becomes a knowledge base, which in conjunction with access to other databases and the close contact to the teacher can contribute to optimize the field stay, before it concludes. These telebased systems also makes it possible to conduct immediate evaluations and implement continuous adjustments of the learning activities. In addition, they can supply inputs to courses on the same topics, which are being conducted in conventional form at the Technical University of Denmark and other institutions of higher learning.

Course materials

Pedagogically, the project relates to a 'classic' problem in social science teaching of engineers and engineering students by building an analytical understanding based upon examples of the solving of specific problems, in which the course participants themselves are involved and which they possibly also document. This approach helps the individual course participant to relate engineering ways of thinking with a social science analytical perspective.

In terms of technology the learning activities are designed as World Wide Web pages, which can be accessed through the Internet via a server at the Technical University of Denmark. Photos, audio and video clips will be used. This is supported by printed materials. Via text and illustrations social science analytical models and methodologies for the study of problems concerning international technology transfers and long-term formation of technological capacities in developing societies are communicated. A number of well-documented cases will be included. On this basis the participants are given assignments, for which they have to collect, process and interpret empirical data from their own local context. The completed assignments are transmitted to the teacher, who immediately feeds back criticism and comments. The content of the assignment will be defined as close as possible to the real situation of working within an interdisciplinary team, which is the most common situation for engineers involved in technology transfers in developing societies.

Timetable

The project is divided into three phases following the calendar year:

1996
The main activity is the development of course materials to be converted to telebased media. This includes the writing of new lectures and the revision and translation of existing materials to be attached to the lectures as resource materials. Furthermore, illustrations, statistical information, graphic interfaces and pointers to other Web-sites have to be developed for the Project Web Site. Also assignments for the course participants and the case stories, on which the assignments will be based, have to be developed.

1997
A test run of the distance learning programme will be conducted and evaluated. The evaluation results will be discussed with the partners, external experts and organisations representing potential users.
The second activity is the development of a telebased teaching and tuition system for engineering students during long-term field studies outside the home country.

1998
A test run of the telebased teaching and tuition system will be conducted and evaluated. The evaluation results will be discussed with the partners, external experts and organisations representing potential users, including student representatives.
The interactive aspect of the two telebased educational activities is strengthened, as a conference system for immediate feedback and learning processes is developed as integrated in the two above-mentioned activities. Also, this system is subjected to a test run and subsequent evaluation.
A documentation of its findings concludes the project, which forms the basis for a final evaluation conference. The strategies for disseminating the findings are implemented.

Expected effects

1. A model of operation for a telebased social science distance learning programme for in-service training of engineers involved in international technology transfers during extended stays outside the home country,
2. A telebased tool for engineering students' work on assignments during field studies, and for continuous interaction between teacher and student.

3. A system of procedures within the two telebased learning activities mentioned in item 1) and 2), which develops pedagogical and professional advances, which immediately can be implemented in the two activities.

Web-site: http://www.its.dtu.dk/proj/arne_w/project.aw/projhome.htm

Flexible Delivery, the Internet and Other Learning Technologies: Factors Affecting Learning.

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Abstract

Much of the literature on the flexible delivery of learning products for vocational education and training clients is based upon assumptions that these diverse clients already possesses the personal characteristics and skills necessary to benefit from flexible delivery of learning products.

The present paper describes research which tests these assumptions. 540 para-professional, skilled and semi-skilled clients, concurrently in employment and training, completed a comprehensive questionnaire which canvassed their opinion about their own level of readiness. They also completed two standardised tests of readiness. Teachers and employers attended videoconference and focus group discussion sessions about their client/employee readiness, their own levels of support for client/employee learning, etc.

Results show that readiness for flexible delivery is influenced by a number of experiential and work-related factors. Clients need pre-course screening, and many require remediation in self-directed learning skills and in the use of technology in order to fully benefit from, and be able to fully exploit flexible delivery. This is particularly so where flexible delivery includes the use of on-line technologies.

Background

According to the Australian National Training Authority, "Flexible delivery is intended to ensure that relevant and effective training is available to all who require it" (ANTA, 1995, p.16). In other words, it should be relevant to, and effectively meet the learning and delivery needs of clients. However, flexible delivery and on-line learning policies in Australia are apparently based upon assumptions that the diverse vocational education and training (VET) client:

- wants to learn through flexible delivery and on-line learning and has the capacity to take advantage of it.
- is sufficiently skilled to access vocational education and training programs offered through flexible delivery and on-line access
- can learn in the workplace.

These assumptions are largely untested and do not acknowledge the difference between Dispositional Readiness and Skills Readiness of clients. The current research tests these assumptions.

Conclusion

This study has found that the assumptions on which flexible delivery and online delivery are based are untenable. The questionnaire responses and structured interview data both support the view that individual VET clients:

- preferred traditional methods of course delivery that are college based and teacher directed
- possessed low skill levels in computer and Internet-related tasks
- possessed low dispositional readiness for flexible delivery, including on-line learning.

On the basis of the current research, assumptions about VET students' readiness for flexible delivery of courses does not seem warranted. Both disposition and skill for self-directed learning were low on an international benchmark scale. Further, there is evidence from the interviews with VET teachers and employers that the VET sector has a limited understanding of flexible delivery and what might be needed for it to be successful. Teachers and employers generally saw the problem as belonging to the student/employee and resulting from poor previous school experiences

In terms of the use of learning technologies, people in the VET sector have limited experience and competency in using them as learning tools. While basic computing skills were evident, their reports did not indicate any real sophistication in higher-order computing or Internet skills. For both present and future learning there was clearly a preference on the part of students for face-to-face traditional delivery in college.. There was little evidence that their VET experiences exposed them to learning using new technologies or developing the skills to be able to learn thus. However, there were some indications that, given opportunity and learning skill, the students might well develop the disposition to learn differently. What needs to happen is an attitude change on the part of students, teachers and employers and attentionneeds to be given to the development of skills associated with flexible learning, particularly skills associated with new learning technologies.

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THE DIGITAL AGORA: INTERACTION and LEARNING in POLITICAL SCIENCE

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Abstract: Acadia University is the first "laptop" university in Canada. The Acadia Advantage program has each incoming student and each faculty member equipped with a laptop computer. In addition, classrooms, library, residence rooms, and common areas are wired so that the network is accessible both in and out of classrooms. This initiative has been accompanied by an educational paradigm shift from instructor-centered to learner-centered. In this paper we will describe one example of the new class of learning support tools that are needed to take advantage of the reality of student-centered, mobile technology. The technology is used to integrate the student experience inside and outside the classroom, and perhaps more importantly, within the campus community and within the world community. The Digital Agora is an ambitious interdisciplinary project that provides pedagogical supports for the understanding and analysis of complex issues in the social sciences, using the web for connectivity both on campus and off campus.

Introduction

Acadia University is the first "laptop" university in Canada. The Acadia Advantage program has each incoming student and each faculty member equipped with a laptop computer. In addition, classrooms, library, residence rooms, and common areas are wired so that the network is accessible both in and out of classrooms. This initiative has been accompanied by an educational paradigm shift from instructor-centered to learner-centered. In this paper we will describe one example of the new class of learning support tools that are needed to take advantage of the reality of student-centered, mobile technology [Conley et al, 1997]. The technology is used to integrate the student experience inside and outside the classroom, and perhaps more importantly, within the campus community and within the world community. The Digital Agora is an ambitious interdisciplinary project that provides pedagogical supports for the understanding and analysis of complex issues in the social sciences, using the web for connectivity both on campus and off campus.

This project recognizes the need for educational support that goes beyond accessing information [Shank and Krass, 1996] and the importance of collaboration in solving complex problems. The Digital Agora is now being used in three political science courses at Acadia, International Politics, Peace Studies, and Introductory Political Science.

The Digital Agora [Digital Agora, 1998] provides an environment in which participants from a variety of backgrounds can appreciate different points of view on complex issues, formulate coherent analyses, and generate well-articulated and well reasoned positions on issues. Participants, therefore, need to do more than just access and read position papers on the web. They need to be producers as well as consumers of information, i.e., active participants as well as audience. Figure 1 shows the home page of the current implementation of the Digital Agora with many of the components available to the participants.

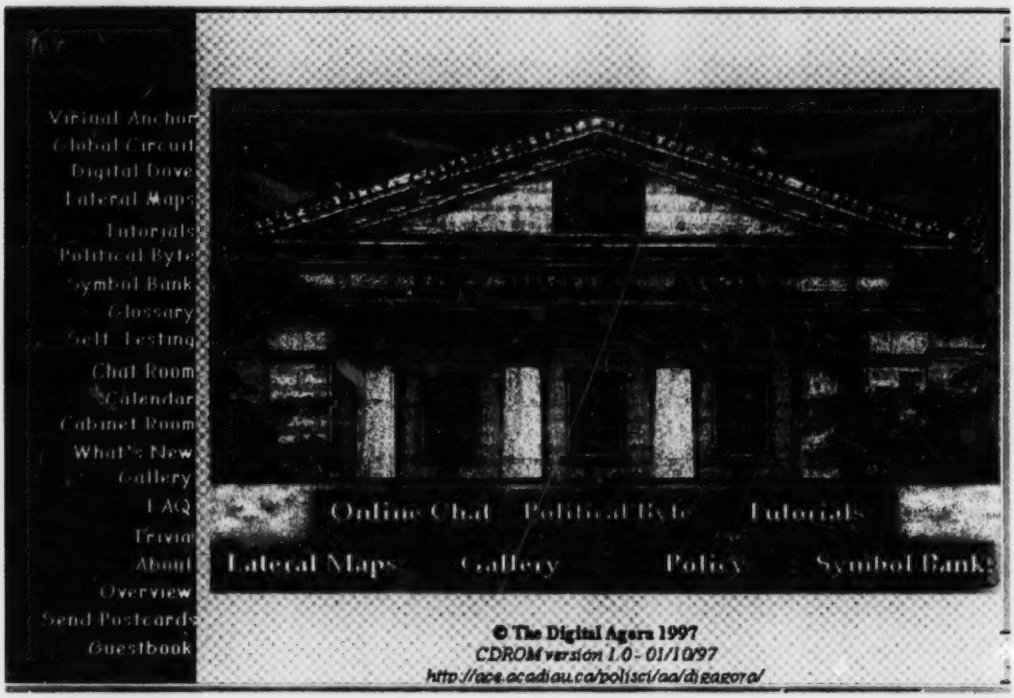

Figure 1: Home Page with Components

The Digital Agora provides support for the following functions:

- access to primary data, such as census data or government policy
- access to secondary data, such as reviews or instructor notes
- simulations, such as economic forecasts or population growth
- generation and editing of lateral maps
- quizzes and evaluations
- presentations
- discussion groups, both open and moderated
- consensus negotiation
- collaborative writing
- shared and private hypertext links
- typed hypertext links on the web
- student authorship, i.e., composition of new nodes and annotations.

In this paper, we describe how we used the web in implementing the Digital Agora and then we examine the limitations imposed on our design by the web.

Why the Web

There are some obvious and compelling reasons for implementing collaborative applications, such as the Digital Agora, on the web, including the following:

- **Scale up.** The web provides us with a huge playing field in which 10 or 10,000 users can participate.
- **Protocols**. URL, HTTP, and HTML protocols are widely accepted.
- **Metaphor**. The use of a document metaphor normalizes the presentation.
- **Access.** Universally available browsers provide a uniform interface.
- **Storage**. We can use a CDROM seamlessly for large scale local data storage.

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- **Connectivity**. Chat groups, newsgroups, and some collaborative support is available.
- **Immediacy**. Authors can add data or make changes and all participants can access this simultaneously and immediately.

What is the Digital Agora

The Digital Agora is an application with many components, most shown in the index frame in Figure 1, that are supported nearly entirely by the web.

- **Course material**. Each course using the Digital Agora has its own course related material: outlines, notes, assignments, etc.
- **Lateral maps**. Lateral maps are visual representations of arguments [Toulmin, 1958] and analysis [DeBono,1982; Novak, 1984; Sowa, 1984] and may be prepared by faculty or by students. Figure 2 shows a sample lateral map, in which the student is expressing her view that within a particular society, there may be clashes between different groups and individuals about which rights to embed in a Charter of Rights. There are currently over 1200 lateral maps available for the students on a wide range of topics, from federalism to multiculturalism.

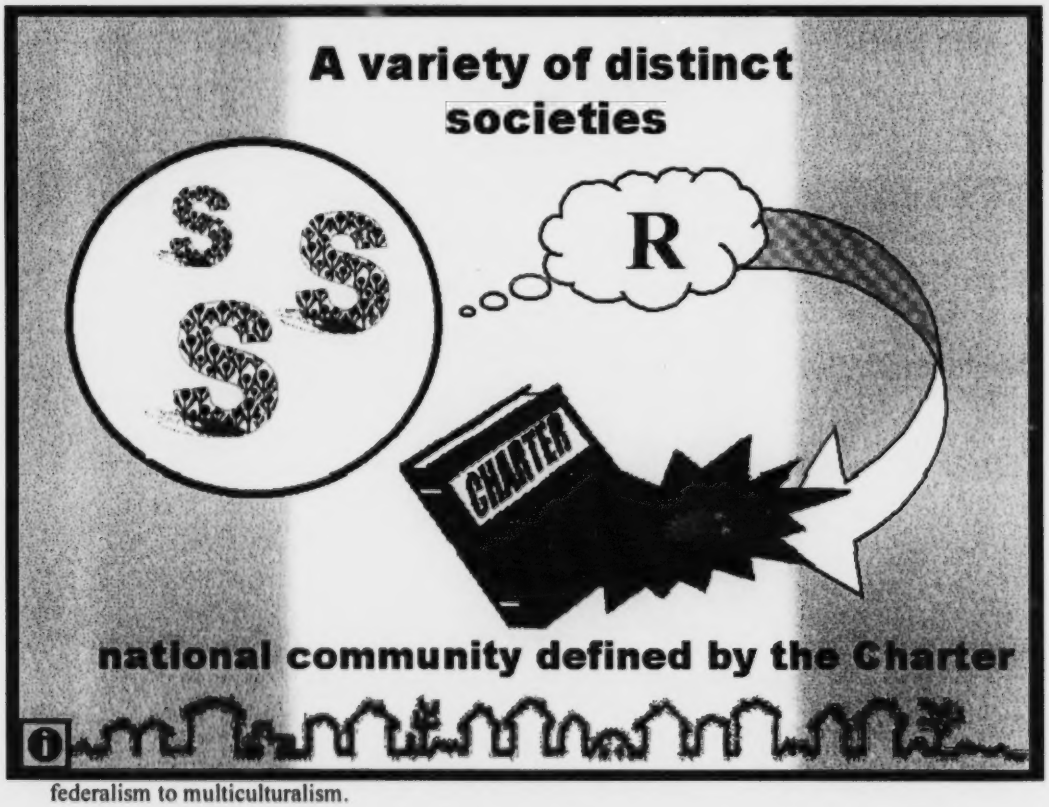

Figure 2: Sample Lateral Map

- **Tutorials**. Video enhanced tutorials are available on essay writing, presentation, etc.
- **Political byte**. Students form collaborative and virtual editorial boards to generate a weekly on-line student "newspaper" dealing with issues relevant to the current topics of discussion featuring current events, historically relevant events, photos, and "letters" to the editor.

Figure 3: Sample Political Byte Newspaper FrontPage

- **Symbol bank**. A shared symbol bank is available with annotations so that students making lateral maps can use symbols that have a shared semantics. Figure 4 shows the symbol bank entries for two of the symbols, society and conflict, used in the lateral map in Figure 2.
- **Glossary**. A glossary of commonly used terms for political science discussion is maintained for the use of all participants.
- **Chat room**. Each course has one or more chat for synchronous communication [ACME, 1998].
- **Calendar**. A Java calendar is included that all participants, private, group, or public, can use. Participants can also edit those calendars for which they have permission.
- **Cabinet room**. This is a class-based collaborative space for discussions.
- **What's new**. Course and general announcements are posted here.
- **Gallery**. The Gallery is a collection that demonstrates, by example, how political ideas are portrayed in art, music, and literature. It helps students tie their ideas into other disciplines.
- **FAQ**. FAQ services are maintained by the students.
- **Trivia**. A revolving set of trivia questions and mystery photos are posted here to challenge students and faculty.
- **Guest book**. A standard cgi-script guest book allows visitors to register and provide feedback.

Large source materials, which include many multimedia components, are stored on a Digital Agora CDROM [Digital Agora, 1998]. This includes over 1200 lateral maps, textual material, photographs, video and audio segments. The CDROM is accessed by the same web browser and links to the internet directly.

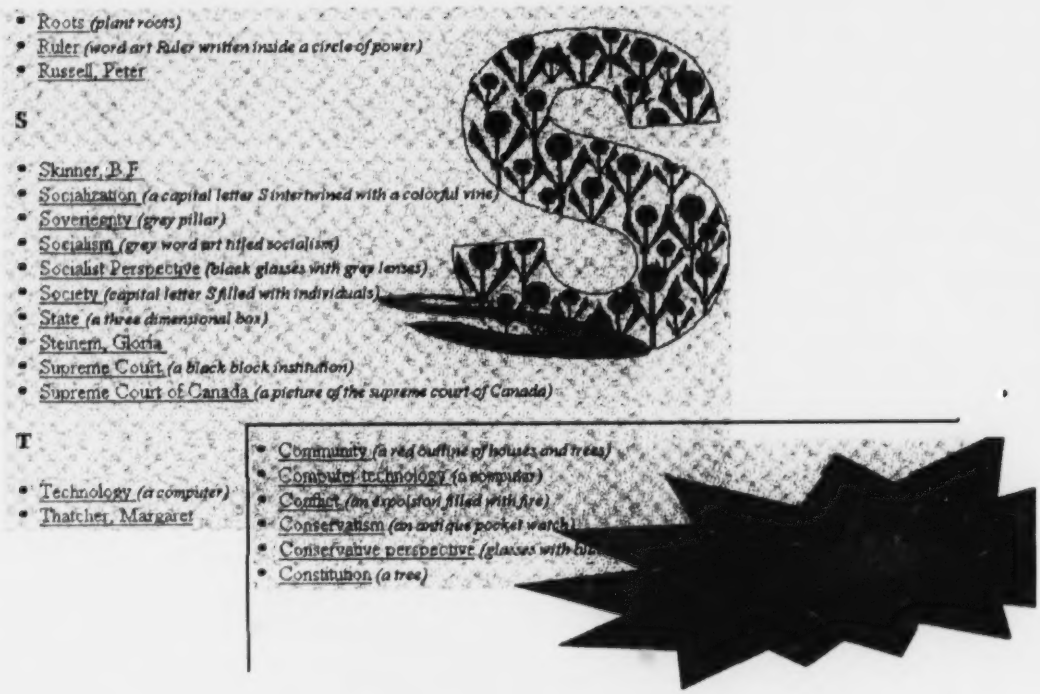
Roots (plant roots)
Ruler (word art Ruler written inside a circle of power)
Russell, Peter
S
Skinner, B.F
Socialization (a capital letter S intertwined with a colorful vine)
Sovereignty (grey pillar)
Socialism (grey word art titled socialism)
Socialist Perspective (black glasses with grey lenses)
Society (capital letter S filled with individuals)
State (a three dimensional box)
Steinem, Gloria
Supreme Court (a black block institution)
Supreme Court of Canada (a picture of the supreme court of Canada)
T
Technology (a computer)
Thatcher, Margaret
Community (a red outline of houses and trees)
Computer technology (a computer)
Conflict (an explosion filled with fire)
Conservatism (an antique pocket watch)
Conservative perspective (glasses with
Constitution (a tree)

Figure 4: Symbol Bank excerpts with images shown for "society" and "conflict"

Evaluation

On line evaluation of student opinion and usage patterns was conducted at the end of the first term. Result from this evaluation indicate that students used the Digital Agora several times a week and used the interactive components, particularly the *Political Byte*, most frequently and rated these as the most useful.

Limitations of the Web

The web provides universal access to huge distributed repositories of text and data that may be relevant to analyses in the political sciences but only rudimentary tools for facilitating the *understanding* of the complexity of issues, the *formulation* of strategies for dealing with these issues and, finally, the *communication* of ideas [Watters et al, 1998a; Watters et al, 1998b].

There are some remaining implementation issues that we found problematic on the web, including lateral map construction, node and link authorship, and semantic links.

- **Lateral Map construction** - Currently the students use Power Point to construct multi-slide, animated, and interconnected lateral maps. Web browsers can handle the slides for presentation purposes but lack a facility that the students can use for significant map construction, either individually or collaboratively.
- **Authorship** - The merging of reader and author roles is a critical feature of the Digital Agora. Users must be both readers and authors. Users must be able to make comments, initiate discussion, and make links while reading, both individually and collaboratively.
- **Relationship Links** - The Digital Agora requires links that denote a specific relationship between the current node and the destination node. These relationships[Toulmin, 1958] would include both predefined

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and user-defined types such as: *example of*, *annotation*, *in support of*, *contrary to*, *same source*, *same topic*, or *aggregation*.

Summary

The Digital Agora is an example of a large inter-disciplinary, inter-institutional project for the support of active learning in the social sciences that has been implemented primarily as a web-based system. The web is a natural medium for this project as the participants are from a wide variety of backgrounds and a range of participation activities are supported from simple browsing to the collaborative generation of new analyses.

Several problem areas remain to be solved in the successful deployment of the Digital Agora as a co-operative learning environment on the web: collaborative lateral map construction, typed hypertext links, node and link authorship by readers.

The Digital Agora is a good example of the next wave of educational support that moves beyond providing access to more information to providing support for the process of engaging in the solution of complex problems as a collaborative endeavor. The use of the web as the backbone for this project exploits the new mobility of students with laptops and allows for the integration of classroom exploration with off-campus collaboration and discussions.

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A Laboratory Platform to Control a Model Railroad Over the Web with Java

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Introduction

This paper describes the work-in-progress of a client-server system to control a digital model railroad over the World Wide Web Using Java. The software engineering objective of this real-time system is to maintain control of multiple digital locomotives each running on the same track layout while at the same time allowing users, anywhere in the world, to manually control the operation of the trains using a Java applet running in a web browser. A video camera is connected to the web server showing the users a video stream of the actual physical train system. The Java client allows the user to: stop, reverse, and change the speed of any train (by address). Also, the user can switch any of the computer-connected turnouts on the layout. The control software (Java server) constantly monitors reed contact sensors to keep track of each train's location and direction, and is continuously performing collision avoidance testing. Each digital locomotive and digital turnout switch responds to computer commands that are sent to its address. The computer system, an Intel Pentium running Windows NT®, runs its own web server at http://javatrains.millersv.edu/. This laboratory platform requires students to utilize and exercise their knowledge of mathematics, physics, engineering, real-time programming and computer science. In this railroad layout there are 4 digital turnout switches, two digital locomotives, and fifteen reed contact sensors to manage and control. The fifteen reed contact sensors are placed in appropriate locations around the track. Magnets are attached to each locomotive, which trip reed contact switches, which are implanted in the track. This configuration provides an interesting, experimental platform for the study of controlling a real-time system using a Java client-server architecture, for undergraduates in Computer Science and Computer Engineering. This laboratory platform requires students to utilize and exercise their knowledge of mathematics, physics, engineering, computer science, and real-time programming. A physical model railroad was used because theoretical modeling and graphics simulations do not always manifest the frustrating and spasmodic problems endemic in actual real-time systems.

Hardware and Equipment

The Java server and webserver are run on an Intel Pentium computer running Windows NT® with 32-MB memory and a 1 GB Hard Disk drive. The Marklin® digital railroad system is used to interface the computer to the track. The Marklin® system is comprised of six interconnected components: a Central Unit, Computer Interface, Keyboard Turnout Control, Track Detection Module (TDM), Control 80f, and a Transformer. All Marklin® modules or components plug together to form a bus architecture between components. The Central Unit is the CPU of the Marklin® system. The Central Unit receives commands from the other modules that control turnouts and locomotives. The locomotives are digitally encoded with a chipset that is addressable, therefore messy block wiring to turn the power on and off is unnecessary. The Central Unit overlays each command on the electric current thereby sending a signal to the track where it is received by the specific decoder for which it is addressed (for example, the C82 decoder chip in each locomotive or the K87 turnout decoder for switch tracks). The S88 Track Detection module (TDM) is an encoder, which translates the incoming signals from the reed contact sensors into a data format that the digital system can then use. The Control 80f module is simply a manual control knob for setting the speed and direction of any digital locomotive. The K87 Digital Turnout control module can digitally switch up to four turnouts. Multiple K87's can be connected in series. The K87 will respond to track switch commands from either the Marklin® Keyboard component or the Computer Interface module. The Marklin® Computer Interface module is the link between the computer and the Marklin® Digital HO gauge system. Using an RS232 serial interface, all the functions of the Control 80f and the Keyboard Digital Turnout module can be sent as commands from the computer to the interface module. In addition, a computer command can be sent to the interface to query the TDM information, which specifies which reed contacts have been tripped. In all, up to 80 locomotives, 256 turnout switches, and 496 reed sensors can be controlled or monitored with the computer interface.

Java Client-Server Software

The Java client allows the user to manually control the operation of the trains from anywhere in the world. This Java applet allows the user to: stop, reverse, and change the speed of any train (by address). Also, the user can switch any of the computer-connected turnouts on the layout. The Java client sends commands to the server to determine the viability of the request. Thus, the user is not permitted to make a change that would cause a crash. If so, the request is denied by the server. The Java server knows the current direction (forward or backward) of each train, its previous position (which sensor it last tripped) and the state (straight or curved) or each switch. Each time a sensor is tripped, the sensor value is used to index a lookup table, which contains the previous value for each sensor on the track layout. In this manner it is possible to monitor the trains without addressable track detection information. The reed contact will signal the fact that a train (a magnet) has crossed the track. However, the contact does not know which train crossed, just that some train (with a magnet) has crossed. Thus, tripping a contact is not an addressable event. Ambiguity can arise due the fact that tripping a contract is not an addressable event. The Java server control software figures out which train it probably is given the monitoring information it is maintaining. For example, suppose the current sensor read is 8 and the direction is 0. The previous sensor would be 14. This value is compared to the location of each train in the data structure. If a match is found the current sensor value is stored in the location field for that train. If no match is found the system issues a TRAINHALT indicating a lost train, and the server shuts down. In this manner the server always knows where each train is at any time and is never allowed to lag behind.

Conclusion

This paper has described the work-in-progress of a Java client-server controller for a digital model railroad. The control software does accomplish its objective of maintaining control of multiple digital locomotives each running on the same track layout while at the same time allowing users around the world to manually control the operation of the trains using a Java applet running in a web browser. A video camera is connected to the web server showing the users a video stream of the train system. The Java client allows the user to: stop, reverse, and change the speed of any train (by address). Also, the user can switch any of the computer-connected turnouts on the layout. The control software constantly monitors reed contact sensors to keep track of each train's location and direction, and is continuously performing collision avoidance testing. The project was initiated to provide an interesting, experimental platform for the study of controlling a real-time system over the world wide web with a Java client-server architecture. This laboratory platform requires students to utilize and exercise their knowledge of mathematics, physics, engineering, real-time programming and computer science. The full paper and further information and source code can be found on our web site at http://cs.millersv.edu/javatrains/index.html.

Acknowledgements

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Controlling a Pepsi® Vending Machine over the Web with Java

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Introduction

This paper describes the work-in-progess of a java client-server system and a special purpose hardware interface to control a Pepsi® vending machine over the World Wide Web. This system allows users with pre-paid accounts to vend a soda from the Pepsi® machine (without any coins) using a web browser such as Netscape. Anyone with a web browser may find out if any of his or her favorite sodas are left in the machine. Also being developed is a java client that notifies the vending corporation, via the Internet, when each soda needs to be restocked. The software includes a Java applet (the client), a server written in 'C' and various server administrative utilities written in both 'C' and Perl. The computer system, an Intel based Linux machine, runs its own web server at http://pepsi.millersv.edu/ and is physically located inside the Pepsi® machine. This project provides an interesting, experimental platform for the study of controlling a real-time system using a java client-server architecture, for undergraduates in Computer Science and Computer Engineering. This laboratory platform required students to utilize and exercise their knowledge of engineering, computer science, and real-time programming. A special purpose hardware interface to control a Pepsi® vending machine over the World Wide Web was built. This hardware and its software manages and controls the vending machine sensors.

The Hardware

The complete hardware system of the Pepsi® machine project consists of three components. The first is the on-board Dixie-Narco vending system built into the machine from the factory. The Dixie-Narco system processes all machine functions, including change collection and dispensing, and soda dispensing. The second component is the main computational engine, an Intel 486 computer running Linux, which handles the Internet interfacing, accounting, and control over the hardware subsystem (the third component) for Internet dispensing of the sodas. The computer system runs its own web server at http://pepsi.millersv.edu/ and is physically located inside the Pepsi® machine. The third component is a special purpose hardware subsystem built at Millersville University, to interface to the Dixie-Narco vending computer. The main function of the hardware subsystem is to control and route the electrical power to the motors, and to decode information from the Intel/Linux machine. The hardware subsystem was assembled using off the shelf electronic components. The subsystem consists of three main components: the ISA Bus Decoder, the Optical Isolator, and the High-power Controller. The ISA bus decoder simply monitors the address lines of the ISA bus on the Intel/Linux machine computer. If an address between decimal 764 through 767 is received by the card, an appropriate read or write data function is initialized. Currently, only address 766 is implemented. Sending an ASCII character to this address will cause activation of corresponding dispensing motors. To derive a given motor actuator number, one must use the formula where x is the number of the dispensing motor that the user wishes to activate. The second component of the hardware subsystem is the optical isolator board. The primary function of this board is to isolate the data signals from the Dixie-Narco computer from those of the ISA bus decoder. The board consists of eight photo cells each having two light emitting diodes (LED) directed toward the cell. Eight of the LEDs are controlled by the ISA decoder bus. Upon receiving the ASCII character on address 766, the number's binary representation will light up on the eight corresponding LEDs. These LEDs cause the photocell to conduct a small amount of electricity which powers the transistor array located on the high-power switch board. The computer must power the LEDs for exactly 500 milliseconds. Sending a pulse substantially longer than the 500-millisecond specification can cause the soda machine to dispense more than one soda.

Additionally, sending a pulse substantially shorter than the 500-millisecond specification can result in no product being dispensed at all. After this time an ASCII null must be sent to the board. This causes the motor to rotate far

machine. The Dixie-Narco computer uses the switch to monitor soda drops. The Dixie-Narco computer uses the normally closed contacts of these switches. To avoid interference with the Pepsi® Project computer, we power the

board. It is the function of this board to control the 120-volt signals that power the eight soda dispensing motors. The board consists of eight 7 amps at 120 VAC relays. The power for the relays comes from the 12-volt supply of

necessary across the high-power board to prevent data errors in the latches of the ISA card. Also, each relay has a diode across its power terminals to prevent a loss of data integrity throughout the system when the relay's coil is

Software

The Pepsi® machine server software, called "pepsid", coordinates all aspects of the networked Pepsi® machine.

the hardware. The pepsid server also maintains the lists of available sodas, as drops are reported by the watcher subserver. The server code is written in 'C' under Linux. The server admin utilities are written in 'C' and Perl. The

bytecodes). When the java applet is loaded into the web browser it creates buttons for each soda. The applet then queries the server for the current number of sodas remaining in the Pepsi® machine. The client connects to the

and reads in the number of sodas remaining in the machine via a colon-delimited string. The main event handler method checks for the press of any button. Pressing a button displays a `PopUpWindow` , asking the user for a user

an output stream and a socket to the server. Finally, the current number of sodas remaining is checked and the socket

Conclusion

Pepsi® vending machine over the World Wide Web. This system allows users with pre-paid accounts to vend a soda

may find out if any of his or her favorite sodas are left in the machine. Further work includes a Java client that

subsystem built at Millersville University, to interface to the Dixie-Narco vending computer inside the Pepsi®

http://cs.millersv.edu/javapepsi/index.html.

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Generating a Common Index for Multi-Authored Web Documents

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Abstract: The Fraunhofer Gesellschaft (http://www.fhg.de/) carries out contract research for small and medium sized businesses. The function of its Web presentation is to direct visitors to those institutes which can carry out their research project needs. Each of the 50 institutes are presented in a "profile" describing their main research areas, as well as, the available laboratory equipment, special devices, contact information, etc. To quickly arrive at relevant information, the visitor has the choice between a full text search system and a key word index in alphabetical order. Hypertext is provided for each of the 7,000 key words linking it to the pertinent information. Cross references give additional assistance in finding relevant key words. The profiles are written by the individual public relations departments of each institute according to corporate standards. Special HTML comments are used to generate a common index. Standards regarding the wording and syntactic rules warrant the automatic coherence of the index. In the case of syntactic errors, the corresponding key word is not inserted into the index, and a message to the webmaster is generated.

Metamorphosis: Metaphors in the Effective Redesign of a Web Site

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Abstract: This research describes the evaluation and redesign process of an academic web site for the Department of Psychology at the University of Florida. Particular attention was given to the incorporation of metaphors into the interface that would improve the accessibility of site information. User activity and navigation within the previous site was assessed through usability testing and analysis of the HTTP access log files. This analysis provided information that influenced the development of several navigational schemes for the site. A description of the iterative prototyping and usability analysis of these designs follows, focusing on metaphor use. In this case, metaphors made the greatest contribution in organizing the content of the site.

New computer policies at the University of Florida require all students to have their own access to computers. Placing this responsibility on students will increase the number of students who own computers and increase the use of electronic communication between students and faculty. With the new computer policies, it is expected that student use of academic web sites will increase. To this end, it was felt that the departmental web page could be a strong link in the communication chain between students and faculty. An evaluation of the existing web site for the Department of Psychology found it to be outdated, disorganized, and inconsistent. The need for a new web site was evident.

Usability analysis for the new web site began with the question, "Who are our users?". In order to address the issue of user identity, the HTTP access log files of the old web site were parsed into a file containing unique user IP addresses and user paths. A Basic program was created to tabulate web page hits from within the University of Florida and those from outside the University of Florida system. Results indicated that 80% of the site's hits were coming from off-campus locations and nearly 70% of our users searched the site for the graduate program. These findings suggested that the new web site should be tailored to students interested in graduate studies in psychology.

User interviews suggested that on-campus users were interested in finding information about their instructors, including how to contact them, office hours, and course information. Therefore, a Perl CGI script was developed so faculty could easily provide this information via online HTML forms. This information was then transformed into individual HTML faculty home pages posted on the departmental site.

Usability analysis revealed concerns about the informational content and navigation of the previous site. As a starting point, students and other users were asked how they thought the Department of Psychology is organized. The most frequent response to this very open-ended question was based on the physical organization of the psychology building. Overall, they conceived of the department as having a main administrative office and different areas for the concentrations within the psychology program. Thus, a building metaphor of this structure was adopted as a navigational scheme.

Interface designers have utilized metaphors since VisiCalc's metaphorical ledger and Xerox Star's desktop metaphor. Applied correctly, the use of metaphors in design can enhance the user's mental model, facilitating human-computer interactions [Smilowitz 1997]. It was thought that giving the user a mental model of an academic building (a very familiar setting to most of our users) would appeal to their prior experience, making the site intuitive and efficient.

Initially, it was thought that the building metaphor could be extended as a design theme. This concept was full of possibilities and grew in complexity. Ideally, this web site would allow people to familiarize themselves with the layout of the building and know their way around the actual building based on their experience with the virtual building. Knowing that most of the users are coming from off campus and are looking for graduate information, it is likely that they are unfamiliar with the building. Expanding on the metaphor, the site would have a sense of place about it. In contrast to the placelessness of the internet, visiting this site would be like visiting the Department of Psychology at the University of Florida in Gainesville, Florida.

The content of the site was organized to fit within the building metaphor. The content of the original web site was scattered and in dire need of streamlining and some kind of efficient, consistent organization. The building metaphor provided a loose structure to adopt. Site mapping of the old site revealed five hierarchical layers of pages, with several unnecessary levels (e.g. a page with no information but two choices of paths), dead ends, and pages under construction. Condensing the levels and reorganizing the structure of the site permitted a shallower, breadth oriented approach to the redesigned site. Administrative, personnel, and general program information was grouped into a "Main Office" and each departmental area contained more specific information about courses, faculty, laboratories, and graduate programs.

In addition to the question of user identity, the distribution of visits to particular pages was deduced from the HTTP access log files. Frequently accessed pages that required navigation through multiple intermediate pages were made more accessible in the new site. It has been shown that more information is remembered from text which is separated into different pages than from a long page of scrollable text [Piolat, Roussey, & Thunin 1997]. Therefore, long scrollable pages on the original site were reorganized and streamlined.

Storyboards of the building as a navigational concept and metaphor were presented to potential users. Using scenarios, users were asked where they would expect to find certain information (graduate programs, undergraduate requirements, faculty email, etc.) in an academic building. Verbal protocols and user ratings indicated that the building metaphor was favored and more successful than the original site.

In the initial web page prototypes, entering the new web site was conceived as entering a virtual psychology building. The main navigation element for these web pages became an elevator panel from which users would select the floor where they would find the appropriate information. Users navigated to particular areas of interest by using the buttons of the elevator panel.

Several prototypes of the elevator panel were evaluated. It became clear that the navigational concept had to be recognized instantly to be useful. User testing revealed that the elevator panel was not an intuitive navigational scheme. Most users did not recognize the panel out of its elevator context. As a result, the metaphor was not communicated and rendered useless. Once users were told that the navigation of the panel was like an elevator, they quickly found information in the site based on their experience and expectations with finding information in other academic buildings. The elevator panel was abandoned in favor of a more direct form of navigation.

In our second series of prototypes, the elevator was replaced by a small 3D line drawing of the actual building. It was thought that clicking on the actual building would emphasize the metaphor of the virtual space as a physical space. This next concept allowed the user to directly click on an image map of the psychology building and the location of each area of interest within the building.

A literal translation of the physical building into a navigational metaphor proved difficult. The actual layout of the building itself is confusing. Years of expanding to accommodate new programs, faculty, labs, and graduate students has turned the building into a labyrinth of doors and hallways with departments scattered throughout. While this magnified our design rationale for a virtual map, using the actual building as a tightly coupled metaphor would make the web site as confusing as the building. Thus, we attempted to simplify the building metaphor with a main office and the general location of the departments which required distorting the building. This generic building metaphor was confusing to on-campus users who knew the actual building.

Another problem with the building was that no aspect of the metaphor provided a way to represent subtopics like departmental requirements, courses, etc.. For these subtopics, the metaphor of an expanding file directory based on that used by Windows Explorer was used on the web pages within each area. Users found this style of navigation to be familiar, recognizing its purpose and function.

To explain the building image as a navigation tool, labels were added to indicate the different departmental areas in the building and, thus, the web site. At this point, it became interesting to note that users were using the labels of the areas to navigate the site, not the building.

To compare this, we prototyped an navigation element that replaced the building image with icons for the five departmental areas and the main office. This navigational element abandoned the building as a navigational metaphor altogether and relied solely on the building as an organizational metaphor for content. Users found little difference between the elevator, building, and icon styles of navigation. All showed the same amount of improvement over the original web site in consistency with user expectations and time to locate a target information. This suggests that the strongest contribution of the building metaphor was in organizing the content of the site rather than navigation. The reorganization of the content made the site easy enough to use that style of navigation was no longer an issue.

In conclusion, evaluation of the previous web site provided the information needed to redesign and improve the site for efficiency and user satisfaction. A detailed examination of the user log files provided an invaluable means to assess the users' identity, interests, and navigation of the site. Prototyping several versions of the site allowed user feedback to direct the development. Consequently, users showed a preference for the redesigned sites. The use of the building metaphor as an information map was not possible in a strict sense due the architectural problems of the building. A comparison of the three different styles of navigation revealed that the underlying organization of the content provided the most improvement in usability. While developing a metaphor for navigation was the initial interest, it was the application of the building metaphor as an organizational model that was successful. These findings suggest that the incorporation of metaphors into the interface can build on the user's real-world experience if used carefully. However, if metaphors are poorly communicated, stretched to extremes, or forced, they can be misleading and limiting.

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Towards a Method for Migrating Courses from the Classroom to the Web

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Abstract: In this paper we describe a methodology for approaching the problem of migrating a course from the classroom to the Web. We propose that there are four main learning modes in the classroom: passive presentation, high level interactive demonstrations, student led practical exercises and reference to written source notes, and that each of these modes can be successfully moved to a Web based course. By way of illustration we describe the *MPI On-line* Web based distance learning course developed at EPCC.

1 Introduction

The increasing size and importance of the Internet has led to growing interest in its use for training and education. For the last three years EPCC has been using Web technology to provide classroom and stand-alone courses [Westhead 96], [Westhead 97], [Minty and Westhead 97]. EPCC has a broad user base with complex and changing training requirements. Our course material must be relevant to hundreds of academic users, industrialists, visiting researchers, undergraduate summer students and in-house staff. In addition we are attempting to extend our training provision by developing a postgraduate diploma in High Performance Computing. This course would use Internet based distance learning as one of its main channels of teaching.

In developing such courses the importance of a model to provide a standard framework for on-line courses is clear. EPCC carried out a detailed study of our current classroom training methods to attempt to identify the key ways in which students gain information. We then looked at ways in which these methods could be translated into an on-line teaching environment. This process is described in the context of one of our distance course, *MPI On-line*.

2 The Structural Model

One of the biggest challenges for any distance learning course is how to keep the student's attention. For example, while detailed course notes complement the oral presentation in a classroom situation, notes were felt by past students to be less effective as the main form of presentation over the Web. This was attributed to the cumulative effect of eye-strain from reading a large amount of material from a computer screen, and the difficulty students had retaining interest while paging through a large document.

In order to develop a strategy for presentation of material in *MPI On-line* a detailed study was carried out of the teaching methods used in the classroom version of the course. Four distinct methods were identified.

1. Traditional oral and visual presentation.
2. Student involvement in demonstration of the theory.
3. Extensive and structured practical exercises.
4. Supplementary reference material.

In the development of the *MPI On-line* course we tried to incorporate these methods while presenting material via the Web. To do this we imposed the following model on the material presented by providing the students with four different modes of access to the material:

1. A multi-media slide show with animated slides and a spoken sound track.
2. Interactive demonstrations provided by browser applets to clarify the material presented in the slide show.
3. Student led exercises supported by the EPIC environment
4. Supporting notes and reference material hyperlinked in to the rest of the material.

So, the seven course modules mixed presentations with demonstrator applets and a practical exercise, throughout which reference materials were made available.

3 EPIC

The *EP*cc *I*nteractive *C*ourseware (EPIC) is an experimental Web based package developed at EPCC. It allows users to interact with editors, compilers and their own exercise code all from a Web page viewed through conventional browsers like Netscape or Mosaic. Thus the student sees a consistent interface irrespective of where they are running the course. Exercises are linked to hypertext notes, standards documents and indeed any relevant material which can be made available on the Web.

The aim is to produce an interactive teaching environment which relieves the user of the cognitive burden of low level details like directory structures, file names and compiler flags. Instead they can concentrate on the course material.

EPIC was originally designed to support a particular type of programming course prevalent at EPCC. These courses are 2-3 day intensive courses each covering a different area of parallel computing with modules consisting of a short lecture with a follow on practical exercise. Such courses apply the Edit-Compile-Run cycle to make successive modifications to a piece of skeleton code. EPIC also provides additional value to exercises based on computational science simulations. In both cases the value of the system is to hide the underlying details and let the student focus on the course content.

A typical exercise page consists of three sections:

Exercise instruction: The instructions are laid out in steps so that the student is led, first through the main exercise, and then through any extra exercises.

Links: HTML links between the exercises and notes. Cross-referencing of sections enables students to find relevant information easily.

Control Buttons: Each page contains buttons to perform required tasks. Those most commonly used include:

Editor - Provides the student with an editor to use.
Make - Compiles the exercise code.
Run - Runs the exercise code.
Skip - View an example solution and, if required, replace the student's program with the example solution. This option is provided because many exercises build on the previous example. A student must have a working version of one exercise before moving onto the next.
Change - Alters exercise parameters, such as the preferred editor and the number of processes to use when running the exercise.
Clearup - Tidies up the file space and closes down any programs which are still running.
Help Enables students to ask their tutor for help.

EPIC is a client based system. It consists of a number of scripts that run on the user's machine which are invoked by the Web browser. Pressing a button on the browser causes a message to be sent to the EPCC web server, which interprets this message with a CGI script and sends back an EPIC command. This command is given a unique `epic` MIME type which identifies it to the browser as an EPIC command in the same way that a browser can identify a Postscript file. The browser then uses the external viewer mechanism which invokes the EPIC scripts locally, passing them the EPIC command.

A client side mechanism removes many of the security issues involved with programming exercises. Allowing unknown users to execute arbitrary pieces of code on your machines is obviously dangerous. Because EPIC's code is always executed on the clients machine there is no opportunity for them to engage in malicious attacks. It also means that in order to run the MPI course the client machine must have the MPI libraries installed.

3.1 An EPIC implementation of the MPI course

The MPI course was one of the first EPCC courses to use EPIC, and remains one of our core courses. Based on the EPCC course *Writing Message Passing Parallel Programs with MPI*, it was first released in Autumn, 1995. The main emphasis of this course was in the provision of on-line exercises although we have also found EPIC a useful tool in the

classroom. *MPI-Online* built on this core work by making use of new technologies such as streamed audio and Java applets to provide a more interactive presentation of the material.

4 Migrating MPI On-line

In this section we describe the development of the on-line teaching environment. The key task was to identify the activities that took place in the classroom course and finding ways to achieve the same effect on the Web.

4.1 Presentation of information

4.1.1 *Slideshow*

The multi-media slide show was intended to be the student's first contact with the material. It exposed them to both the general concepts, and a certain level of detail. It was our intention that the slide show should contain all the material essential for completing the exercises. In our MPI On-line course each slide show was between 10 and 20 minutes long, and although it would present itself, automatically flipping the slides in synchrony with the sound track, the student was able to stop the presentation at any point and replay bits that they found unclear.

As with the classroom course, *MPI On-line* the slide show is the key method of putting across information. Combining audio and visual presentation including animations and demonstrations (see [Practical Demonstrations]) allows information to be absorbed more easily. In *MPI On-line* the slide show is accompanied by a streamed audio presentation tailored to the slides.

The slides are constructed using a specially designed authoring package called the *Web Lecture System (WLS)* written by Rick Klevans which makes use of Progressive Networks' Real Audio technology.

4.1.2 Animations

During the classroom course, students are encouraged to take part in practical demonstrations of message passing. For example they pass envelopes around the room to indicate communications. In *MPI On-line* many of these demonstrations have been recreated using animated GIFs. These provide a useful method of presenting concepts and keeping students interested by providing a contrast to the slide show and soundtrack. Stills from the animations are shown in Figures 1 and 2.

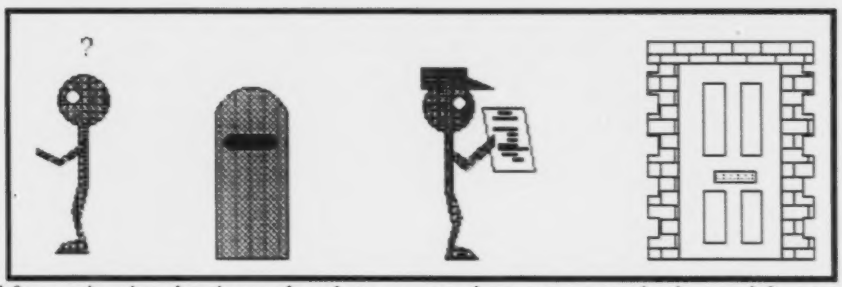

Figure 1: Still from animation showing analogy between asynchronous communications and the postal system.

4.2 Practical Demonstrations

In a classroom setting it is clearly much easier for students to ask questions and resolve areas which are unclear to them. In order to help clarify the students understanding and reinforce the information they have retained we built interactive examples that simulated some of the higher level concepts in the course. These allowed the students to explore their understanding of the concepts and discover problems before they are faced with the detailed programming exercises.

At this stage the aim is to ensure that concepts rather than their implementation are understood, so the exercises do not require the student to do any programming. Instead exercises are based around interactive examples and multiple choice questions implemented using Java applets. These were developed in collaboration with the SELLIC project.

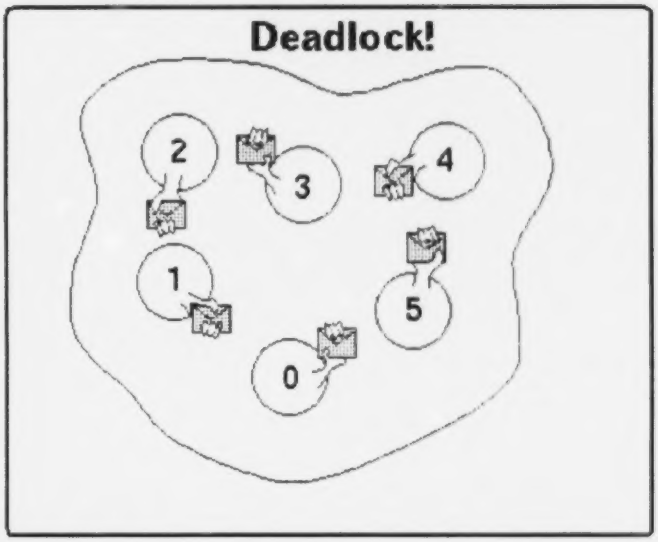

Figure 2: Still from animation showing deadlock of synchronous blocking communications

4.3 Practical Exercises

Courses developed within EPCC concentrate on the practical application of material being taught. A typical classroom session would consist of a 30-minute lecture followed by a 60-minute practical. With distance learning, the importance of practical reinforcement increases as exercises provide the only means for trainers to ensure that students have fully understood the material.

The EPCC MPI course has a large practical content. Exercise descriptions contain hyperlinks to the notes and references to the MPI standards document. In addition example solutions are provided to allow students to check their work. Email support is also available via the tutor button described below.

4.4 Reference Material

A version of the course notes and the MPI standard are provided. These can be viewed via the Web or printed as hardcopy, depending on the individual student's preference.

The course notes explore the same subjects as *MPI On-line* but in a more discursive manner than the session presentation. In addition, they cover a wider range of MPI routines than are examined in the course. However they do not contain comprehensive descriptions of the MPI routines themselves. That information has been left out with the intention of encouraging students to make full use of the MPI standard document. It contains information on all the MPI routines rather than the subset included in the EPCC course notes.

4.5 Student-Trainer Interaction

One of our goals in developing EPIC has been to provide a supportive structure in which students can easily present problems to a remote tutor for expert guidance. The tutor can 'virtually' look over students' shoulders to assist them with exercises.

The tutorial system automatically checkpoints the student's progress at set intervals during an exercise. If they face a problem they feel unable to resolve, the press of a button will package up the current exercise state and send it to an expert tutor. The tutor can then see a screen identical to the student's combined with a description of the problem and guide the student to a solution via e-mail.

To support the UK National Supercomputing Service, EPCC already maintains a sophisticated semi-automatic query system in which emails arrive at a central point and are directed to an appropriate member of staff. This provides an

ideal method for answering and monitoring *MPI On-line* queries. Throughout the first *MPI On-line* course in September 1997 course tutors were made available to deal promptly with any query arriving from an *MPI On-line* student.

5 Discussion

MPI On-line was run as a supported course for the first time in September 1997. It proved very successful and we received a great deal of positive feedback. The animations and interactive demonstrations were particularly effective.

On the other hand we were disappointed that the tutor button was barely used. We feel that there are four probable causes for this:

- The button was tucked away so that the user had to first press help in order to be presented with it.
- We arranged to have staff available to respond to tutor requests in under an hour. However we failed to advertise this sufficiently prominently so students could have been left thinking that they might not get a response from us for days.
- People inherently seek the easiest solution to their problems. In a classroom situation asking the tutor for help is often easier (though may be less educationally useful) than looking the answer up for oneself. In these situations the students may have felt it less effort to find their own help than describe it in an email and wait around for a reply.
- The students on this course run were all in institutions with expertise in these areas. There may have been people on hand at these sites who could help them directly with their problems.

In general the biggest weakness we see in the course at the moment is the limited amount of human interaction available to the student, in particular student-student interaction. The Internet provides exciting opportunities for group learning experiences, although it is not clear that these are appropriate for this material. However we certainly plan to increase the opportunities for students to interact with distant tutors and with each other.

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Web Places:
Enriching At-Risk Education with a Project-Based Learning Environment

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Abstract: This paper summarizes the development and evaluation of *Web Places (WP)*, a prototype web-based template system that allowed students at risk of academic failure to publish educationally rich projects on the Internet. The objective of this study was to assess the feasibility of the *WP* concept in the context of at-risk education. Seven at-risk high school students used the prototype system to develop and publish a project on the Internet. Pre- and posttest data about the students' attitudes toward *WP*, learning, and technology were collected. The results indicated that *WP* was a useful tool for teaching and motivating the students. *WP's* potential for future development, evaluation, and application is discussed.

Education research indicates that, instead of focusing exclusively on the basic skills of at-risk students, teachers should encourage disadvantaged learners to practice more advanced skills by allowing them to participate in project-based activities [Waxman, Huang, Saldana, & Padron, 1994]. When producing projects, students are able to explore new domains, interact with instruction, understand the application of learning activities, collaborate with peers, possibly design instruction for others, and learn advanced skills [Means, 1994; Duttweiler, 1992]. *Web Places (WP,* http://www.web-places.com), a project that used the Internet's educational potential to increase the chances of success for at-risk students, was designed to incorporate each of these characteristics. By providing students (and teachers) with templates for publishing educationally rich projects on the Internet, *WP* allowed them to help shape their own education. The user-friendly templates alleviated the technical burden of developing a web page and allowed students to focus on learning and developing ideas. This paper summarizes the work conducted to develop and evaluate the prototype *WP* template structure.

The *WP* installation used an Internet server to host software and project data. Students and teachers interacted with the server using a standard Internet client on desktop computers. The server also provided students with access to materials on the web, acted as a publication vehicle for projects, and linked the installation to a central site. The template was configured for the project according to the number of students involved, the volume and type of material, and time spans. The configuration elements resided on the server and included an interactive, web-based project manual and facilitators' guide, a repository for project materials, and a web-site for publication of the materials. The dynamic project manual guided students in filling in the infrastructure with content. As materials were entered into the project's repository, a publication system created a web site for the project. Through a system of access restrictions, the site was first reviewed by the project team and then by teachers. When deemed ready for publication, the site was opened for general access.

The objective of the prototype development phase was to assess the feasibility of implementing the concept in an at-risk educational setting. Seven high school students were selected to participate in the study. All of the students were considered at risk due to factors such as economic status, race, parent marital status, or family circumstances. A pretest-posttest research design was used to address the research questions. The measures

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included a structured interview, a computer experience questionnaire, and the Self-Esteem Index [Brown & Alexander, 1991]. Each measure was administered to each student privately.

Five research questions were formulated to evaluate feasibility. Overall, the results indicated that *WP* has potential for improving at-risk education. The findings for each research question are summarized below.

1. To what extent does the *WP* concept attract and engage at-risk students?

All of the students were enthusiastic about the project and about working with technology, producing a web-based project, and learning new information.

2. What kinds of materials and content do at-risk students develop for *WP* projects?

The students were concerned about the image of their school as well as the image of American teenagers and the social issues affecting them. Therefore, they chose to produce a project about the media's portrayal of four relevant issues: school uniforms, teenage pregnancy, standardized testing, and treatment of gay students. The students collected various forms of media (e.g., newspaper articles, Internet sites), analyzed the media's portrayals, and discussed their opinions on the issues, using a point/counterpoint format.

3. Do the *WP* templates provide sufficient support for the development of *WP* projects?

A partial version of the conceptual design described above was implemented as the prototype, providing the project manual, facilitators' guide, project web site, and materials repository in a single configuration. Each of these elements was skeletal, with rough placeholders instead of finished text and graphics. Nonetheless, the partial implementation was functional and allowed materials to be entered through the project manual, reviewed via the facilitators' guide, and published via the project web site.

4. What critical issues arise in the course of *WP* implementation?

Results of the study indicated that the students needed a more structured work atmosphere, including more guidance on developing the project and more time allowed for work. It is important to encourage students to do their own thinking while helping them to focus on the goal and develop a feasible project concept.

5. What are the effects of *WP* on individual students and the school as a whole?

The overall effects of the *WP* project were beneficial. Students reported that they learned how to do research, work on a team, and manage their time. They also gained new perspectives about their topics and learned about the benefits of technology. There was a slight decrease in computer use, confidence, and enjoyment. This change may have been due to the school's placing severe restrictions on computer use during the course of the school year. In general, there was a slight increase in self-esteem. However, at pretest, most of the students scored above the 50th percentile on the Self-Esteem Index.

The next phase of *WP* development will address the issues encountered during this study. A wizard, search tool, improved system for collaboration, and more flexible and sophisticated data entry and revision tools will be incorporated into future implementations. In addition, future *WP* projects will be integrated with curricula and class activities. In addition to increasing the amount of guidance students receive, this integration may promote effective peer tutoring, as more heterogeneous groups can be formed. Future work will also incorporate a more robust research plan, using a larger number of subjects and more *WP* templates.

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A Virtual University Model

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Abstract: The virtual university (VU) is a term used to describe a growing range of projects and enterprises, ranging from *clearing houses* listing a range of distance courses offered by more than one institution to the full scale *new institution* delivering its own fully accredited degree courses. In developing any virtual university it is important to clarify the differences between organisational structure, technical infrastructure and content. This paper examines the different types of organisation developing and proposes a three layer model for the virtual university.

1. The Model

This paper proposes a three layer model for virtual universities. Each layer of the model has, associated with it, a number of issues which will have to be addressed by any virtual university.

Organisational Layer	Infrastructure Layer	Content Layer
• Structure • Copyright • Quality assurance	• "Virtual Campus" - Look and feel • Registration and Payment • Student support services • Assessment mechanisms • Discussion mechanisms • Content delivery systems • Student tracking	• Static HTML • On the fly HTML • Learning environments • Formative assessments • Summative assessments

Table 1: The Virtual University Model

1.1 The Organisation Layer

1.1.1 Structure

A growing number of "virtual universities" have emerged since web technology began to be used extensively for education in 1995. These can be broadly classified under three categories: *virtual front ends* for single existing institutions, *collaborative ventures* involving genuine collaboration between existing universities, and entirely *new institutions* created for the delivery of online education. In addition there are two further types of website which call themselves virtual universities. Online *clearing houses* bring together the distance courses offered by a range of institutions. There are also various *commercial enterprises* that do not deliver accredited university courses.

All bricks and mortar universities now have a web presence. In most cases these pages are the gateway to information for staff and students giving and taking courses traditionally. Some institutions, such as Michigan State University (http://vu.msu.edu/) have chosen to create a *virtual front end* separate from their main university web server. This offers access to the online, distance courses delivered from the university, aimed at students who find traditionally delivered courses inconvenient. As increasing numbers of lifelong learners are drawn to higher education, and online learning forms a more significant part of the courses offered by existing universities, the distinctions between main web sites and *virtual front ends* are likely to blur. Universities such as the University of Phoenix (http://www.uophx.edu/) in the USA, and Britain's Open University

(http://www.uophx.edu/) already delivering courses primarily by distance are likely to find this transition relatively painless.

The *collaborative venture* between existing universities is a model that combines the strength and credibility of more than one institution. Funding can be attracted more easily where several universities come together and resources are pooled for maximum impact. Clyde Virtual University (http://cvu.strath.ac.uk/) was one of the first joint projects to develop along these lines. Bringing together staff from four universities in Western Scotland, it has attracted national government funding since 1995. It currently provides online modules within traditionally delivered degree courses, accredited by the existing institutions. The Western Governors' University (http://www.westgov.org/smart/vu/vu.html) was founded in 1997 as a non-profit, independent institution bringing together the expertise of academic institutions across 16 states for the delivery of new courses, accredited by the new organisation rather than the existing universities.

A few entirely *new institutions* have been created to exploit the demand for distance learning. Notable among these is The International University (http://www.international.edu/). Based in Denver, Colorado, the Internet-based organisation has applied for accreditation from the Commission of Institutions of Higher Education of the North Central Association of Colleges and Schools. Such credibility is sorely lacking on some of the programs that have become known as "digital diploma mills" delivered by unaccredited organisations. Warnings such as that over Columbia State University (http://www.degree.net/news8/csualert.html) will not help quality new institutions to bridge the credibility gap.

There are several instances of the institutions within one geographical region combining information on their distance education provision within one web site and its associated organisational structures. Established by executive order of the Governor of California, after a decision to leave the Western Governors' University coalition, California Virtual University (http://www.california.edu/) contains links to the 45 accredited colleges and universities in California which currently offer distance courses. A similar website in Finland, the Virtual Open University of Finland (http://www.avoinyliopisto.fi/), lists the courses available at 19 Finnish Open Universities. Neither of these projects is set to evolve into a single cyberspace entity; indeed the philosophy (http://www.virtualu.ca.gov/welcome.html) behind the California Virtual University is specifically against the creation of a new bureaucracy competing with existing universities. One *clearing house* not linked to any particular region is the Globewide Network Academy (http://www.gnacademy.org/), which lists over 15,000 courses and programs Worldwide.

By no means "universities" in the sense that they do not offer accredited degree courses, some *commercial enterprises* such as Price Waterhouse Virtual University (http://www.vu.pw.com/), have built their own websites to meet the training needs of a single company.

1.1.2 Copyright Issues

Virtual Universities whatever their organisational structure must have clear policies on copyright and ownership of materials. This can become particularly problematic within *collaborative ventures* where online courses are often developed by several individuals from more than one institution. Who holds the copyright to the final product, the leading academic, the course team as a whole, the lead site, the consortium or a combination of these? The answer is that each party may have some claim to the copyright but that this depends on contracts of employment and the terms of the agreements which should be made before content is built.

1.1.3 Quality Assurance

As with the delivery of traditional higher education, a system needs to be put in place to assure the quality of Internet-based courses. Rigorous and regular testing and evaluation of materials and methodologies are necessary. A system designed to review curriculum, environment and resources, teaching and learning, assessment and standards of achievement, guidance and support is essential to ensure that standards of quality are upheld. California Virtual University has produced an extensive academic plan

(http://www.virtualu.ca.gov/Faculty/AcademicPlan/acplan-full.html) outlining the roles and responsibilities of each institution and detailing how quality will be assured in virtually-delivered courses.

1.2 The Infrastructure Layer

This is the layer which is often most visible when visiting a site. All large Web sites need a consistent and distinctive look and feel. VUs are no exception and many use the campus metaphor for at least the top level of navigation. The infrastructure of a VU must also include extensions to the basic Web server. Without the addition of registration systems, assessment mechanisms, discussion mechanisms and the like a VU would be no more than a document store. The extensions can be implemented as CGI programs, servlets or any other technology.

1.2.1 The Virtual Campus

A number of excellent examples of virtual campus front ends exist such as Clyde Virtual University (CVU) (http://cvu.strath.ac.uk/), Howard Community College (HCC) (http://www.howardcc.edu/) and FernUniversität (http://vu.fernuni-hagen.de/). Imagemaps are the usual way to implement these top level menus. The number of choices offered varies widely; at the time of writing, CVU offers a choice of five "buildings" in its virtual campus while HCC offers fifteen "buildings" along with other clickable street furniture such as a mailbox, a phonebox and road signs. The campus metaphor is rarely continued within the site where traditional navigation icons tend to take over.

Consistent navigation is necessary when content has been created by many authors with different backgrounds and probably with different ideas about how their material should look.

More advanced implementations of the campus metaphor, such as VRML, may provide something more immersive but could restrict the user base without alternative, lower technology, navigation mechanisms.

1.2.2 Registration and Payment

Linked closely with how the VU is organised, not all VUs will have to deal with virtual payment systems. All VUs will have to "identify" their students in one way or another and this implies the requirement for some form of registration. The management of the large amount of registration details that can be generated by just a small VU can be a major problem if not properly planned. Registries of traditional universities can absorb large amounts of resources and it is likely that even well planned and implemented VUs will still require what at first sight seems like a large amount of staff time relative to the amount of time spent on authoring the VU content.

1.2.3 Student Support Services

The student accommodation office may be redundant in the VU but counselling and advisory services may well be more important to the student who studies at a VU. How these services are organised and staffed must not be overlooked in the haste to capitalise on the economies of scale that a VU offers.

1.2.4 Assessment Mechanisms

Assessments, both formative and summative, are crucial to any educational experience. VUs have to offer a mechanism for testing student achievement. Formative assessments will almost certainly be integrated into the content of the courses. This might make the content less portable than it would otherwise be but the advantages of tight integration of content and formative assessment are many.

Summative assessments can also be delivered from a VU but problems of user authentication and plagiarism become very important. It would be possible to deliver a traditional exam via the Web only if the students were in a room of computers under traditional exam conditions. A move toward innovative methods of summative assessment is, in some respects, desirable so long as academic quality is not compromised.

1.2.5 Discussion Mechanisms

Student-student, staff-student and also staff-staff contact has to be supported in some way. In an online environment the simplest discussion mechanism might be email, but this is not very sophisticated. Basic email systems can be improved dramatically by adding mailing list managers and mail archives. Email can then easily be targeted at particular groups of students and a permanent record can be kept of all email exchanged within the student group. Systems such as WWWBoard (http://worldwidemart.com/scripts/wwwboard.shtml) and HyperNews (http://www.hypernews.org/) provide a Web-based alternative to email lists for asynchronous discussions. Sophisticated, non Web-based (but, more recently, Web accessible) systems such as Lotus Notes (http://www.hypernews.org/) and FirstClass (http://www.softarc.com/) are widely used for asynchronous discussions. Synchronous or "real time" discussions can be supported by Internet Relay Chat, EWGIE (http://www.eit.com/ewgie/) and various other systems.

1.2.6 Content Delivery Systems

If the course material, which will be discussed in the content layer, is stored as something other than HTML then some mechanism for generating Web pages on-the-fly is required.

1.2.7 Student Tracking

Monitoring students' progress is important in any university, VUs are no exception. Results from formative and summative assessments will provide vital data but tracking students' progress through the content may also provide useful information. Most Web servers will log access information. Analysing the server's log file to provide useful information regarding individual students remains a challenge.

1.2.8 Integrated Systems

Many systems are now available which integrate a number of the functions of the infrastructure layer (http://www.wbtsystems.com/, http://homebrew.cs.ubc.ca/webct/). Basic systems help automate the authoring and delivery of Web-based content and might include assessment and discussion mechanisms. More advanced systems will take care of student registration and payment, user tracking and content organisation and offer an attractive front end to the courses. Comparative analyses and critical reviews of integrated learning packages are available on the Web (http://node.on.ca/tfl/integrated/eye/).

1.3 The Content Layer

Web-based courses are the reason VUs exist. Many VUs have developed from simple collections of course material. As the range and number of courses increases, the need to impose some sort of structure becomes ever more pressing. The organisation of the content will depend largely on the type of institution. The way the content is authored, stored and delivered to the student could be any of a number of options available. As the content will probably be provided by many different authors it is quite possible that different courses will be authored, stored and delivered in different ways on the same VU.

1.3.1 Static HTML

Web-based courses will probably have started life as a collection of HTML pages, perhaps with a few inline images. For the author this is relatively easy to produce, perhaps using an HTML authoring tool such as HotMetal (http://www.softquad.com/products/). Although simple and straightforward, static HTML does have problems. Maintaining a site's consistent look and feel can be very difficult when authors are creating their own HTML. The quality of the HTML can vary greatly (using an HTML authoring tool is no guarantee that the HTML produced is correct). The rigorous use of an HTML validator is recommended. Use of discussion areas and formative assessments within the course requires the careful integration of pages generated by CGI programs.

1.3.2 On The Fly HTML

Given the need for some of the CGI generated pages within the content it is worth considering the "on the fly" generation of all the content. Control over the look and feel is taken away from the author and consistency is guaranteed. Linking in discussion areas and formative assessments becomes trivial. However, authors are now forced to use a particular authoring tool such as Toolbook II (http://www.asymetrix.com/products/) and the portability (and reusability) of the material is lost. Authors are also constrained by the limitations of the chosen delivery system, while innovative use of technologies such as Java and VRML might be difficult if not impossible.

1.3.3 Learning Environments

Organising information into sequences of Web pages with added discussion areas and formative assessments produces adequate but not particularly engaging Web-based courses. A more imaginative approach, that can be usefully mixed with the basic approach, is to challenge students with a task which has to be accomplished within a virtual environment. These environments could make use of VRML and simulation engines to provide truly interactive learning environments in which groups of students could hone their skills.

1.3.4 Formative Assessments

The design of well graded formative assessments can provide vital feedback to students who may be isolated from any human feedback. The design and delivery of multichoice and multiresponse questions is well documented (http://www.qmark.com/). Multichoice style questions can be quite limiting in nature and it may be useful to have a wider range of question types available. Integrating Java Applets with an assessment mechanism allows for a much wider variety of question types including drag and drop and questions which encourage critical self assessment (http://cvu.strath.ac.uk/admin/cvudocs/caa2lboro/).

2. Conclusions

This paper has introduced a model for virtual universities that comprises of three layers. The organisational layer defines the structure of the organisation and addresses issues such as copyright and quality assurance. The infrastructure layer is concerned with the underlying technology necessary for the delivery of courses and assessments over a virtual university. The content layer defines the format of the learning materials themselves. Each layer of the model has associated with it a number of issues. All VUs must carefully address all of these issues if they are to prove effective. Others issues will emerge in each of the three layers as VUs develop.

Strategies for Evaluating Innovative Web-based Courses: A Case Study

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Abstract: The emerging forms of Web-based learning bring into play new pedagogies and contexts that require the evaluator to look beyond conventional methodologies and instrumentation. This paper explores the use of Web analysis tools to illuminate the structure and processes of student utilization of Web-based learning materials. A theoretical rationale for their applicability is developed, and their practical utility investigated in an evaluative case study of Web-based university course tutorials.

The explosion in the growth of Web-based courses and course components currently underway requires a rethinking of some of our traditional approaches to evaluating learning and teaching. Many of these new courses differ from more traditional instructional forms in ways that go beyond their use of technology, offering new ways of teaching and learning that bring new challenges to the practice of evaluation. They typically have a broader range of goals than conventional courses, seeking not only to instill mastery of a given knowledge domain, but to promote new forms of individualized and interactive learning that engage the student more completely and develop a broader set of learning skills. The outcome-oriented assessment strategies commonly used in the evaluation of traditional direct-teaching pedagogies and conventional curricula simply fail to address some of the more important questions and issues around the new Web-based teaching. This paper outlines some of the most common pedagogical perspectives and educational goals driving these new approaches to education, and considers how these are to be assessed in practice, offering a case study of an evaluation currently in progress. It focuses largely on issues of process and formative evaluation, for two reasons. First, little purpose would be served here in reviewing modes of outcome assessment focussed on factual knowledge and procedural learning that are already well known and extensively researched. It is the more process-oriented outcomes that these courses promote that require an extension of the evaluator's repertoire of methods if they are to be adequately assessed. Second, despite its profuse growth in many different forms over the past few years, Web-based education has been subject to limited systematic research. We need to learn how the attributes of different implementations of this mode of learning impact students' learning processes and work practices so that we can develop a range of best practices for various educational contexts.

Web-Based Pedagogy: Going Beyond Traditional Goals

In the more developed implementations of Web-based and Web-augmented courses, there is an apparent shift in both philosophy and practice away from the direct teaching paradigm [Harasim, Hiltz, Teles, & Turoff 1995]. Teaching and lecturing in groups which provide little opportunity for individual exploration is replaced by a more self-directed learning context, in which students work at their pace and time, using both on and off-line resources to build knowledge in new ways. An important goal of these new programs is to help students become more active participants in their learning by fostering their capacity to seek out, synthesize, and evaluate relevant information and develop the necessary skills in their field of study.

A second element that is fundamental to most Web based courses is the fostering of learning as a collaborative activity. Despite the physical grouping provided by the traditional lecture section, it hardly bears repeating that in most cases very little collaborative or shared learning is pursued in this context. The short weekly tutorials

available to students often provide very limited opportunities for interaction or collaboration. Web-based learning environments usually have a conferencing component, in which students are encouraged to question each other and discuss relevant issues, problems, and emerging understandings. Class assignments and projects are frequently collaborative rather than individual, and in general there is increased emphasis on the pedagogical importance of the social construction of knowledge [Scardamalia & Bereiter 1996].

Web based learning generally takes advantage of the net's capacity to provide content in several media in order to give students access to a more diverse range of subject matter representations. The diversity is intended both to heighten student interest and involvement in learning and promote greater understanding by taking advantage of different learning modalities. It is argued that dynamic media such as video clips and animations can be used to present procedural knowledge in a more understandable manner than static text, and that graphics and photographs can be utilized to map out interrelationships more clearly than linear verbal representations.

A Case Study

These, then, are some of the perspectives and rationales being articulated by those advocating Web-based learning. How can we evaluate these claims, and what can be done to help course developers enhance the value of their offerings? The relatively greater importance placed on the factors discussed above suggests that any assessment needs to incorporate elements that go beyond conventional outcome measures to look at students' learning paths, the frequency and nature of student online interaction with peers and tutors, the educational value of the Web based course components, and students' perspectives on their experiences. Some of these factors are being examined in a formative evaluation of a Web based tutorial for an Introduction to Computers freshman course at York University in Toronto we are currently conducting. This tutorial consisted of several modules for self-directed study that covered much of the course curriculum, and were intended to supplement class lectures. They incorporated many dynamic multimedia elements to illustrate and explain key procedural concepts (e.g. logic gates and their combinations in multiplexors) and provide diverse ways of studying the course content.

Our chief goal for this study has been to understand students' experiences of the tutorial from both an objective and subjective perspective. In order to assist in the ongoing development work, we want to help the developers see how students engage the tutorial modules on a number of levels as well as to illuminate users' perspectives on its different components and design features. Because students were accessing the tutorial from different locations and at their own convenience, making direct observation difficult, we collected data on patterns of use indirectly, using a commercial Web log analysis package to study the "tracks" of users who had worked in the tutorials. The package allows us to gather data on the frequency of tutorial use, the frequency with which different tutorial pages and media elements were accessed, and the frequency with which the various possible paths through the materials were followed. This will make it possible for us to develop a clear picture of what routes were most favoured, what elements viewed more frequently or were repeatedly viewed, and what portions (e.g. "sidebar" elements offering deeper explanations of a concept) received little attention. (This study is in progress now; initial results will be presented at the conference session). Focus groups are being used to gather data on students' expectations of and experiences with the tutorials, and to elicit their valuations of the structure, content, and features of the units.

Other key elements

Because our study is being conducted at an early stage in the implementation of the Web course, when it is still being used as a supplement to (rather than a replacement of) traditional tutorials, outcome measures have not been employed. In cases where course offerings online are more comprehensive, a strong argument can be made for some form of assessment of achievement. A second element that would be vital to many Web course evaluations that has no application in the present case is an analysis of the ways in which students work

together (typically via online conferencing) to develop understandings and complete projects. Conferencing systems provide a very convenient archive of these interactions, which offer a richer field for the exploration of social phenomena in education that is normally readily available. Such analysis can contribute greatly to our knowledge of the value of this mode of teaching.

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Redesigning a Course for New Media Delivery

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Abstract: The University of St. Thomas is offering a new version of its music literature course geared toward the non-traditional student. This papers outlines the development process and highlights the instructional technology components.

Introduction

At the University of St. Thomas, we are investigating various ways of opening our courses to non-traditional students. Our task was to redesign a music literature course so that approximately half the face-to-face sessions could be eliminated. In an effort to ensure an instructionally effective employment of technology, we followed a rigorous instructional design and software development process. The result is a robust set of materials in various media.

Process

An instructional designer and our content expert began by examining the course curriculum. The result of this work was an exhaustive list of learning objectives, stated in behavioral terms. They then reviewed the methods and materials used in the course as it is traditionally delivered, identifying a list of methods, activities and materials that supported each instructional objective.

Using this work as a foundation, the designer and content expert then took a fresh look at the objectives with an eye toward meeting them with a larger variety of media. At this stage, nothing was off limits. Approaches delivered via video, audio, CD-ROM, and web were considered in addition to paper and face-to-face. Eventually materials and activities were related to each of the instructional objectives.

Then, it was time to organize the content into a syllabus. At this point, attention returned to the original goal of eliminating half the face-to-face sessions. We did a rough resource estimate for the new materials being considered for development and finalized the list. A development schedule was established.

The content expert, an instructional designer, a programmer and an art director participated in designing all computer-based and internet materials. A common look and feel was established. At the end of the design phase for each piece, a document was created that described the flow of the program and its look. This design document was distributed to the production staff and testing coordinator.

The art director and audio producer developed a list of assets for each piece. A team of graphic artists and audio engineers created the assets and delivered them to the programmer who integrated them into the structure of the program. During the production phase, changes were often made to the design for aesthetic, technical or interface reasons. Sometimes one of the staff involved in production might have noticed a problem or sometimes a student reviewer might reveal flaws in the design. Any time a change was made, the designer created a design document revision and distributed it to all parties.

All materials were then tested, according to a plan that the testing coordinator created. Any incidents were recorded on a form that was reviewed by the coordinator, programmer and project manager. Incidents deemed significant were addressed and the materials were tested again.

Once testing was complete, the materials were prepared and duplicated. The initial offering was limited to a class of 14. Support was available both via the website and the University of St. Thomas help desk.

Technology Components

Technology components were developed to complement the selected text and an associated audio CD set. From the outset, all content in the developed materials was original. This was done to avoid copyright problems but also made sense instructionally: we didn't want to duplicate content already available in the other sources.

Multimedia Exercises

A set of seven multimedia exercises was developed for delivery via CD-ROM. Each of the exercises focuses on a basic concept or set of concepts. Usually, the student explores the concept, then self-tests. For example, in the "Melody, Rhythm and Harmony" exercise, the student first explores the concept of a medium range melody by watching the computer play an on-screen melody while the notes appear on a staff above it. In the self-test section, the student is presented with the piano and the staff and creates a medium range melody. Feedback is given to guide the student.

"AudioGraphics"

A listening tool was developed to be used in conjunction with the audio CD set. This program resides on the student's hard disk. Students select the assigned composition and the program displays a color-coded graphic derived from the sound wave for the selection. When the student presses the Play button, the audio CD plays while a synchronized cursor moves through the graphic. Instrumentation and other features of the composition are noted within the graphic. The student may click anywhere within the graphic to hear the composition from that point. In this way, the student has an interactive graphic representation of the piece that facilitates analysis of such aspects as theme while at the same time offering a visual distinction among the composers represented in the program.

Web Journal

One of the pieces of the web site is an electronic journal. Because the site is password protected, each student's journal is viewable only by the student and the instructor. In addition to providing a place where the student may express thoughts or problems with the content, it is also a place where students may record music criticisms that are assigned. The student may review, edit, print and delete any entries later. The instructor may review entries for any or all students.

Web Quizzes

For each week of the course, the student takes a quiz within the web site. The format of the quiz is multiple choice. The quizzes are meant as self checks. The student completes the quiz and submits it for judging. The results of the quiz are displayed for the student. Any missed items are displayed so that the student can compare the correct answer with the response. The results, noting incorrect items, are also emailed to the instructor. This means that, prior to a face-to-face session, the instructor can identify troublesome concepts and spend extra time with them in class.

Other Web Materials

In addition to the syllabus and the tools listed above, the web site contains pages for each week that introduce the topics under study and list assignments and due dates. There is also a discussion forum where a student may pose questions and comments for reply by other students and the instructor. There is also a page with links to related sites and an extensive help section where students may turn if they are having problems with any of the materials developed for the course.

Challenges to the Optimal Delivery of A Web Based Training Program

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Introduction

The promise of Web Based Training, commonly referred to as WBT, has many companies initiating efforts in the development of a training program for delivery via the Web. Despite the increased attention WBT has been receiving from the Training community there are current challenges affecting the development WBT that must be addressed.

This article will address two related challenges facing educators, trainers, and others when developing a training program for delivery over the Web. These challenges are:

1. Connectivity Speeds
2. Response Times

Connectivity Speeds

Users of the Web connect to it via a multitude of modems operating at a variety of speeds. According to Georgia Tech's Graphic Visualization and Usability Center's (GVU) 8th WWW User Survey most Web users (55%) connect to the Internet at modem speeds 33.6K or less. The study also notes that 21.3% of the respondents were unsure of their connection speeds, and almost half (44.54%) of those users who were unsure of their connection speed describe themselves as novice users. Assuming a small percentage of these novice users are connected at slower speeds, a reasonable case can be made that more than 60% of Web users connect at speeds of 33.6K or less.

The fact that 60% or more of Internet users connect at slower modem speeds brings into question the wisdom of using certain media and Web technologies in WBT:

Video – The use of non-streaming video clips creates a pause while the trainee waits for the file to download, interrupting the flow of the training. New video streaming technologies improve the performance of video on the Web, making video less of a challenge than it had proven to be in the past. The use of streaming video on the Web, compared with non-streaming video, is much more desirable.

Java – Java is held in high regard by many in the Internet community. Java's promise of sharable, re-usable applets written in cross platform code (also known as "right once - run anywhere") rightfully creates enormous excitement with Web developers. Initially the hype was so exciting that many web sites introduced Java interfaces or they spiced up their home page with a Java applet.

That excitement has faded slightly as Java experiences growing pains. Many of the same sites leading the charge in the use of Java have since removed their Java interface and/or applets in response to user feedback. It seems the use of Java interfaces and applets on Web sites were causing users long delays while they waited for the Java to load.

While Java holds much promise for the future, the current limitations in bandwidth mean it is likely to be a year (at least) or two until these limitations are adequately addressed. An excellent discussion on the state of Java today and the problems it has yet to overcome, "Why are we using Java Again?" by Paul Tyma, may be found on page 38 the June 1998 issue of Communications of the ACM.

Response Times

Couple the fact that users primarily connect at low speeds with information about response times in computer mediated environments, and we see how important it is to understand how a training audience accesses materials provided via the Web.

Here are the three important limits in response times according to Nielsen (1997):

> -- 0.1 second is about the limit for having the user feel that the system is reacting instantaneously, (no special feedback is necessary).
>
> -- 1.0 second is uninterrupted flow of thought limit
> (a delay is noticed, but no feedback is necessary)
>
> -- 10 seconds is about the limit for keeping the user's attention focused on the dialogue. The user should be given feedback indicating when the computer expects to be done.
>
> Source: Jakob Nielsen's Alertbox – Response Time Overview
> http://www.useit.com/alertbox/responsetime.html

At the current connection speeds which users access the Web, it's highly unlikely many users are experiencing page response times of 1 second or less. In order to truly develop a working environment where the pages are returned in less than a second, all users would need extremely high bandwidth. As mentioned above, this is not an option that will be available to users any time soon.

According to Nielsen, after 10 seconds a user loses concentration and will focus on other things aside from the task at hand. During a training program, a distracted trainee is likely to lose her concentration numerous times if she must continually wait for pages to load. It is doubtful you will have an effective training program if a trainee is constantly losing focus due to delays.

Based our discussion regarding modem speeds earlier in the paper, its clear that low optimal response times are difficult to achieve. It could be argued that users are conditioned to the fact that waiting for information on the WWW is normal. However, to develop training assuming such a user mentality is not the answer. Consideration must be given to the expected response times of Web pages in a training program delivered online. This in turn is impacted by how users connect to the Web. All of which impacts how one should design training programs for delivery on the Web.

In order to design Web based training for the lowest common denominator (slow user connection speeds with sensitivity to response times) here are a few ideas to improve optimal page transition: 1) If video is required, use streaming video. 2) Keep the graphic file sizes to a minimum, and be smart about how you use graphics. Don't add pictures for the sake of adding them. Make sure they serve a specific purpose or get rid of them. 3) The use of Java in web pages should be kept to a minimum. If you are sold on using Java, try to write small applets, as this will help to reduce the amount of time users wait for it to load.

Conclusion

Web based training has been receiving more attention lately as companies discover the benefits of using the Web as a delivery vehicle for their training. The attention is rightly deserved – the WWW platform will have a significant impact on the future of training. In order to fully realize the potential of the medium, it is also important to understand its current limitations. The two obstacles to effective Web based delivery of a training program mentioned in this article (User connectivity, Response Times) are challenges with potential solutions. Until these challenges are addressed however, they must be considered when designing a training program for delivery over the Web.

Making Sense of the World Wide Web: The Application of Library Practice

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Abstract: The chaotic nature of the Web confounds the researcher who wishes to identify useful Web resources. This paper focuses on some ways in which traditional library practice provides a methodology for approaching the Web: ranging from methods for organizing and accessing pre-existing resources to methods for enhancing resources at the point of creation. Library practice, which has informed the selecting, organizing and accessing of information, provides a methodology for introducing an authorial voice into the Web environment.

1. Introduction

The nature of the World Wide Web poses considerable challenges for the scholar or student who wishes to identify and locate Web resources of use to research. The rapid pace of growth; the wide range of quality, audience, and purpose; and the lack of standards for identifying the content of documents, are among the factors that confound the researcher. Equally important is the way that hypertext affects the organization and presentation of information. On the one hand, the endless flexibility of hypertext links, coupled with the Web's openness to user input, add to the democratization of communication. On the other hand, this same flexibility breaks down the traditional hierarchy among texts and subverts the authorial voice.

In contrast to the Web, the traditional library can be seen as a well-defined and organized physical space. In addition, its services do not stop at the walls of the building. Librarians have always been aware of the greater pool of published materials and of other collections--libraries, historical societies, etc.--which provide potential sources of information. Traditional library practice, which has informed the selecting, organizing, and accessing of information, also provide a methodology for approaching the Web and introducing an authorial voice into a chaotic environment. This paper will focus on a few select ways in which library practice has meaning for the Web: ranging from methods for organizing and accessing pre-existing resources to methods for enhancing resources at the point of creation.

2. Organizing Pre-Existing Resources

Librarians have always acted as intermediaries between information and users; they select resources based on predictions of user needs, and organize them for future identification and access. One important way intermediaries function on the Web is by creating hierarchical subject trees of selected, annotated resources. Users may browse these trees, moving from general to specific topics in a way that enhances the precision of their search. While there are no standard subject headings used by all trees, each has an internal consistency that guides the user to appropriate information.

Subject trees may focus on a narrow topic or may pull together resources from many topics in a form reminiscent of the traditional "bibliography of bibliographies." One of the best and most comprehensive of these trees is the *Argus Clearinghouse* [Argus 98] begun at the University of Michigan School of Library and Information Studies and maintained by a team of consultants who hold degrees in library and information science. Since 1993, this team has encouraged the creation of subject-specific guides to the Internet and has provided information architecture design services. While the Clearinghouse guides vary in their focus, organization, comprehensiveness, and timeliness, most provide good starting points for investigating a topic. The *Clearinghouse* also rates its guides to help users judge their value.

Another subject tree is the *WWW Virtual Library Project* [Virtual 98] begun at CERN in 1991 and

now maintained by volunteers, many of whom are librarians. This tree includes an experimental Library of Congress Classification System, a step toward the standardization of Web resources.

Many subject trees include a search tool for their selected resources, not to be confused with the comprehensive search engines that try to encompass the entire Internet. One good example is *Infomine* [Infomine 98] maintained by participants from all the University of California Libraries and Stanford University Library. *Infomine* provides annotated links to research and educational materials in a wide range of subjects. Its search mode allows Boolean searching within each of its broad subject categories. Search results also provide pointers to other categories of the *Infomine* tree which may include resources on the user's topic. This type of searching is somewhat analogous to performing a keyword search on a online catalogue; the results of the initial search indicate specific subject terms for use in subsequent searches.

The Web also contains bibliographies of resources for specific topics. Expanding on traditional print bibliographies, many provide citations to both print and Web resources with hypertext links to the Web documents. One excellent, frequently updated example is *The Scholarly Electronic Publishing Bibliography* [Bailey 98]. The *Bibliography* includes citations to articles, books, and electronic resources with appropriate links to full-text Web resources. The *Bibliography* may be browsed via its table of contents or searched using Boolean logic.

3. The Library Catalogue and the Web

The creation of a subject tree or bibliography is a systematic exercise imposing order and authority over a defined collection of resources. However, the need to integrate these resources into a single finding tool remains. The natural choice is the library catalogue, which is still the most persistent authorial voice for managing information resources. While subject trees may provide flexible keyword searching and subject classification, only the library catalogue provides rigorous authority control: the establishing of specific forms of names and subjects to be used throughout a set of bibliographic records.

The library catalogue, which has been online in most libraries for many years, uses standard rules to describe, classify and provide authority control for resources. Long before the emergence of the Web, library catalogues have provided rigorous access to information in a wide variety of formats: print, microform, audio tape, CD-ROM, etc., so the user need not predetermine the format of desirable resources. The catalogue ensures that a single item may be accessed in a number of ways: by author, title, and one or more subject headings, so that users with only partial information about a resource will be able to identify and locate it. Indeed for many library users, who may never approach an information desk or consult with a librarian, the catalogue performs a valuable public service. It is the job of the cataloguer to anticipate the needs of the user and the questions the user may have about the content, location, and usability of resources.

Keeping their individual user communities in mind, librarians have never attempted to catalogue all published information indiscriminately; instead, collections librarians select appropriate resources, and cataloguers work to make these resources as accessible as possible. Even within a given subset of published materials, cataloguers do not attempt to create all records from scratch. The sharing of catalogue records among libraries has been an established practice for many years, beginning in the days when major libraries published their catalogues in print form, and continuing through to the sophisticated, online, world-wide sharing that exists today. Cataloguers represent an established, objective, and cooperative body of professionals accustomed to addressing the growing world of information resources and the changing needs of their user communities.

Given the proven talents of cataloguers for responding to user needs, the library catalogue can be seen as a natural vehicle for organizing Web resources. This, it should be noted, is a far different thing from "cataloguing the Internet" in its entirety: an overwhelming and probably unnecessary task.

A growing number of libraries have begun enhancing their catalogues by adding URLs to existing records. For example, at Wilfrid Laurier University, we identify URLs for online versions of publications and add them to our records [TRELLIS 98]. We are particularly concerned with showing the connection between items previously available in print and now available electronically.

Other libraries are creating records specifically for Web resources. One catalogue that includes many such resources is Washburn University's [Washburn 98]. To isolate the Web records in this catalogue, search

for the subject "internet resource." The URLs embedded in the retrieved records link directly to the Web. More and more, libraries are providing web-based versions of their catalogues, thus simplifying the connection to Web resources [webCATS 98].

Of course, given the unique characteristics of Web resources, existing cataloguing standards must be expanded and modified. However, it is important to realize that cataloguing standards have been evolving for many years to allow for new subject areas and changing terminology as well as new formats of information. The first edition of the present standards, the *Anglo-American Cataloguing Rules*, was published in 1967, followed by a second edition (AACR2) in 1978 and revisions in 1982, 1983, 1985, 1988 and 1993. More revisions can be expected as cataloguers respond to changing needs.

As in most disciplines, theory follows practice. For the purpose of gaining this practice, a number of projects have been undertaken. Two of the most important have been the 1991/92 OCLC Internet Resources project and the 1994-96 OCLC Internet Cataloging project.

The first OCLC project focused on a sample of 300 resources to determine if Internet resources could be catalogued using USMARC format and AACR2 standards. With some exceptions, existing standards were found to be adequate. The second project solicited worldwide participation of librarians to select resources according to local collection development policies and then to catalogue them. As described in [Jul 98]: "By the end of the project, 231 participants representing nearly all types of libraries had selected and cataloged some 4,707 Internet resources." As of late 1997, more than 16,000 Internet resources had been catalogued by about 500 different OCLC-member libraries. Together, the OCLC projects have "demonstrated the applicability of the USMARC format and AACR2 cataloging rules to the creation of description and access records for Internet resources" [Dillon & Jul 96].

A Canadian project [see Campbell & Cox 97] exploring problems and solutions for cataloguing Internet resources is the Cataloguing Internet Resources Project (CIRP) initiated by the Faculty of Information Studies (FIS) at the University of Toronto. Participating academic, public, school, and special libraries select appropriate resources which are catalogued at FIS. The database of catalogue records can then be used by all participating libraries.

Projects such as those at OCLC and FIS have highlighted the challenges of cataloguing Internet resources and suggested solutions that involve changes in cataloguing standards. One result has been the publication of guides to aid cataloguers in their work. For example, [Olson 97] followed from the OCLC projects. The CIRP project used this manual and other resources to produce a draft of standards, which was distributed to the libraries participating in the project.

Some of the challenges faced by cataloguers suggest fundamental problems in the way that Internet resources are produced and identified. For example, one ongoing problem is the changeable nature of URLs: it is impossible to produce a definitive catalogue record for an item when its "call number" could change at any time. Work has been done by the Internet Engineering Task Force to develop a Uniform Resource Name (URN), though the process of implementing new standards is slow. In the meantime, OCLC, which is actively involved in developing URNs, has produced a Persistent Uniform Resource Locator (PURL): a naming and resolution service for Internet resources. As described in [Weibel et al. 97] this service associates a PURL with the actual URL of a resource and returns the URL to the client. PURLs have been developed to allow for a smooth transition to URNs once that architecture is in place.

The structure of a URL must be viewed with caution as a source of publisher information. As [Campbell & Cox 97] discovered, "The URL does not necessarily reflect the hierarchy of the organization that produced the site, and great care must be taken to distinguish the organization responsible for the content from the organization upon whose site the document is mounted."

Another problem is identifying where one document ends and the next begins in order to provide accurate and meaningful descriptions of specific documents. Cataloguers at FIS [see Campbell & Cox 97] determined that Web sites fall into two main types: independent documents with "their own self-enclosed integrity," and sites that "serve as a gateway for broader resources," such as computer programs which must be downloaded by the user. In the latter case, the document description must extend beyond the home page of the resource to include the computer program.

Another challenge stems from the constant updates and revisions that affect the content of many Internet resources. The FIS cataloguers [see Campbell & Cox 97] dealt with this problem by identifying two distinct types of site revision: those which apply incremental additions and those which maintain a basic skeletal structure but change individual elements. The former were determined to be analogous to serials,

while the latter were treated as loose-leaf services.

4. Metadata: The Dublin Core

A major ongoing problem for cataloguers is the lack of standards for identifying key information about a resource, such as author, publisher and subject. In addition, a method is needed to identify and access the variety of formats found on the Internet, such as images, sounds and video. One proposed solution is the use of metadata or "data about data": elements embedded within the META tag of Internet resources to enhance description and accessibility. It is important to realize that the concept of metadata has long been used in the creation of library catalogues and traditional indexes and abstracts. The challenge has been to apply this concept to a networked environment.

OCLC and the National Center for Supercomputing Applications are sponsoring a series of workshops to foster the use of metadata in networked resources. So far, five Metadata Workshops have brought together librarians and information technology professionals. At the first workshop, held in Dublin, Ohio in 1995, a core set of metadata elements was identified [Weibel et al. 95] "to describe the essential features of electronic documents that support resource discovery." This set of elements, known as the Dublin Core, allows authors and information providers to describe their resources for themselves, using a straightforward framework.

The Dublin Core standard has been stable since the third workshop and has been implemented in a number of projects: over 30 were reported [see Hakala 97] at the fifth workshop in October 1997. One of the most famous implementations is NORDINFO's Nordic Metadata Project [Nordic 98]. Slated for completion in 1998, the project is creating basic elements for the production and utilization of metadata. Software and documentation used for this project will be available in the public domain.

It is important to realize that while such systems as the Dublin Core have the advantage of being relatively easy to implement, the catalogue records created are still deficient when compared with full MARC-format records that have quality control at the point of creation. For example, while the Dublin Core contains the concept of author, it does not have a way to identify "main entry": a uniform access point for identifying and accessing an item. Also missing is the concept of "added entries": additional access points, such as joint author or editor. Dublin Core participants continue to debate the relative merits of enhancing the core elements versus keeping the system simple and accessible to all creators of resources.

The Dublin Core is intended to complement existing resource descriptions: both the relatively crude indexes generated by search engines and more sophisticated catalogue records. An important feature of the Dublin Core is that it is "syntax-independent," meaning that element descriptions are independent of encoding methods and should be mappable to other syntaxes, such as MARC [Crosswalk 97]. Given the limitations of the Dublin Core, such as the the lack of main and added entries, [Caplan & Guenther 96] describe how machine mapping has proven problematic. However, the Dublin Core provides a solid foundation for human cataloguers to apply MARC syntax and enhance records for use in library catalogues.

5. Conclusion

An important purpose of the Metadata Workshops has been to bring together relevant groups, including librarians, the Internet Engineering Task Force, and text encoding researchers, to help integrate their related activities. As librarians work cooperatively with those in related professions, library practice continues to evolve and to enhance the usability of Web resources.

An awareness of the successes, challenges and on-going projects involving library practice can help the non-librarian wishing to make sense of the Web for various purposes. The researcher attempting to navigate the Web may use the many subject trees and enhanced library catalogues and may suggest resources to be added to these tools. The creator of Web resources may consider standards for metadata such as those developed by the Dublin Core. Web researchers may work cooperatively with librarians who have a long history of managing information resources. While the Web poses particular challenges to users and researchers at all levels, the basic principles of selection, organization, and access, as defined by library

practice, continue to prove their relevance and adaptability.

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Web Based System for Fetal Telecardiology

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INTRODUCTION

In the United States almost 100 babies are born every day with congenital heart diseases. In many, perhaps even most cases existence of abnormality surprises the mother as well as the doctor taking care of her during the pregnancy. It is a common opinion between doctors that ultrasound scan of a fetal heart during the pregnancy does not decrease mortality caused by congenital heart diseases. Unfortunately this is partially true. The main reason for such situation is a paradox: the detection of congenital heart diseases depends on non-cardiologists. It is the responsibility of obstetricians and primary care physicians. Today's modern ultrasound machines provide adequate technology to study fetal heart, but still more important than equipment is keen observation and understanding of fetal cardiac abnormalities.

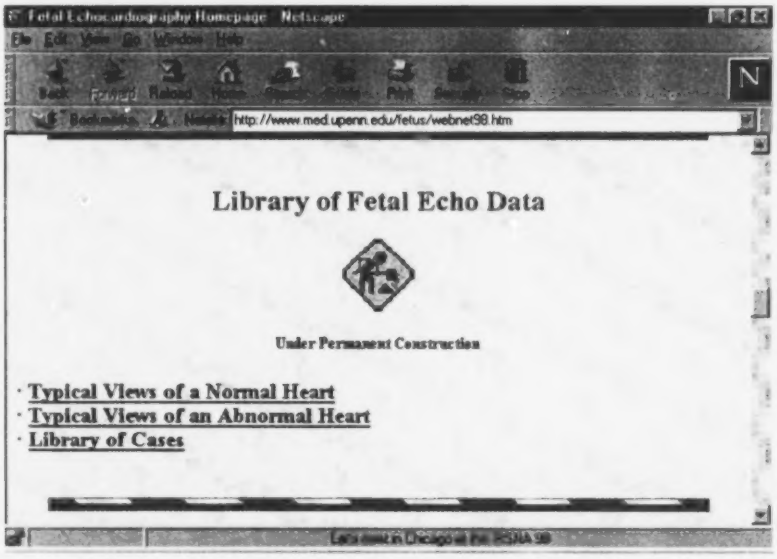
Fetal Echocardiography Homepage - Netscape
http://www.med.upenn.edu/fetus/webnet98.htm
Library of Fetal Echo Data
Under Permanent Construction
· Typical Views of a Normal Heart
· Typical Views of an Abnormal Heart
· Library of Cases

Figure 1. The opening screen of the image library

Most of non-cardiologists are not properly trained to detect heart abnormalities. Obtaining a god image of a fetal heart is also non-trivial. In reality, in many cases untrained physicians are supposed to detect abnormalities while analyzing poor images. It simply does not work, and unless defects are severe they remain undetected. The cases that are detected usually are so severe that even early detection does not change anything. But the situation is not hopeless. Today's computer technologies can be utilized to

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support a process of making diagnoses and improve the detectability of congenital heart diseases. The goal of our project is not to convert obstetricians to cardiologists, but to use modern computer technologies to help them to detect abnormalities, and after detection provide proper diagnoses, and the treatment.

THE PROJECT

The goal for this project is to develop web based tools for effective teaching of medical personnel how to read and analyze echo data, and to support the process of making correct diagnoses. The Fetal Echocardiography Homepage [Wróblewski et al. 1997], [Larkin M 1997], located at the url: **http://www.med.upenn.edu/fetus** is a central part of this approach. It contains the largest free library of fetal heart images. Over 100 high quality ultrasound images and video clips obtained using different ultrasound techniques: 2D-echo, Color Doppler, M-mode, and Pulse Doppler together with a growing library of cases. The opening screen of the image library is shown in Figure 1.

The page contains also program for gestational age calculation (in weeks) based on typical ultrasound measurements: biparietal diameter, head circumference, abdominal circumference and femural length. The empirical equations obtained by the polynomial fit using data from 120 carefully selected patients are as follow:

$$age(AC) = 0.75425*10^{-3} * AC^2 + 0.06019 * AC + 9.2207$$
$$age(BPD) = 0.8821*10^{-2}\ BPD^3 - 0.78710^{-2} * BPD^2 + 2.6392 * BPD + 6.8819$$
$$age(FL) = 0.002182 * FL^2 + 0.2094 * FL + 10.693$$
$$age(HC) = -0.10967 *10^{-4} * HC^3 + 0.8462 * HC^2 - 0.09887 * HC + 17.906$$

where: AC - abdominal circumference in mm
BPD - biparietal diameter in cm
FL - femural length in mm
HC - head circumference in mm

It is also possible to upload to the page video-clips of interesting cases and discuss them publicly, or to obtain consultation from the specialists from the Children's Hospital of Philadelphia and the University of Pennsylvania . The homepage is written in HTML, Java Script and MIVA. It contains links related to fetal cardiology sites and electronic journals where it already has been cited or referred to. Since it's creation in August 1996 Fetal Echocardiography Homepage was accessed for over 15,000 times. The screenshot of the entire page has been already published in the "Internet Resources for Cardiology" edited in Japan [Nakajima et al. 1996].

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An Architecture for Dynamic Courseware Working on the Web

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Abstract: We have devised an architecture for dynamic courseware working on the World Wide Web. Inherent in the architecture are two components: Authoring Server and Courseware Server. With the associated mechanisms, the approach enables the working of dynamic courseware - composed of widely dispersed learning-related materials on the web, to function for a particular learner.

Introduction

Conventional courseware approaches like CAI tend to be rigid and lack the dynamicity to address individual learners' needs. 'Dynamicity' here means the flexibility of courseware content in meeting the different requirements of different learners. With the emergence of the WWW (World Wide Web) or Web it now became possible for learners to access the myriads of teaching materials available via the Internet. Thus making it feasible for the creation and functioning of dynamic courseware. With the Web, the latest and most updated information can also be gathered. However, the learners have to first face a significant problem: they have to cope a vast amount of materials and to navigate through links which sometimes are not relevant to their learning goals. Very often they get lost in the hyperspace and loose a focused perspective on what they want to learn! Moreover, most of these materials are dispersed and inherently disparate, making their exploitation in an integrated manner difficult [Gruber, Vemuri and Rice 1998]. Searching and retrieving relevant information from current retrieval mechanisms provided by the prevailing search engines like Yahoo, Alta Vista, Infoseek or Webcrawler are also futile as the results are mostly of low precision [Gaines & Shaw 1997].

In this paper, we report on an endeavour towards the realization of dynamic courseware working on the Web. Namely, through the imposition of an architecture for the creation, retrieval and adaptation of materials for learning purposes.

The Architecture

A basic assumption of our approach is that courseware is consisted of modules of units of concept-topics [Gagne 1985]. While a concept may be illustrated via a number of topics, a topic is treated as the most fundamental unit in a courseware piece.

There are two major components in the architecture: AS (Authoring Server) and CS (Courseware Server) (Fig.1).

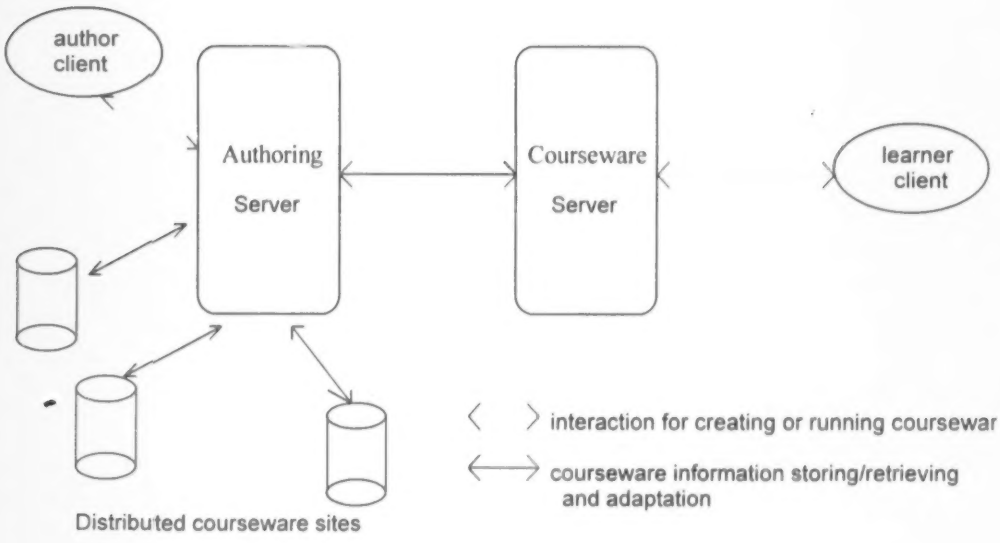

Fig.1: An architecture for operating dynamic courseware

Referring to Fig.1, a client-server approach is adopted in the working of the architecture. With learners and authors/teachers being clients using the services provided by the Authoring Server and Courseware Server respectively. (Here a client is assumed operating with a Web browser.) The teaching materials are expected distributed on various sites in the Web.

Related Mechanisms

Associated with the architecture for running dynamic courseware certain mechanisms are also imposed. Basically these mechanisms involve the manipulation of information on some defined templates. At the moment, there are three standard templates developed, they are:

i) Courseware-Information-Template (CI-Template) containing
- Subject domain information
- Description of relevant topics
- Information related to Uniform Resource Locator (URL/Web Site Address)
- Information related to the medium of teaching
- Information related to pre-requisite level required of the course

ii) Curriculum-Template (C-Template) containing
- Information related to the difficulty level of the courseware
- Topic structure, e.g. relations amongst topics for instructional planning
- Mastery level required of the course
- Teaching example for illustrating the topic
- Exercise for practising understanding of the topic
- Hint for exercise

ii) Teaching-Style-Template (TS-Template) containing
- Possible instructional method(s) used for using the courseware
- Information related to assessment
- The way instruction logic of control is determined
- The way of monitoring the learner's state of learning

Basically the CI-template is coupled with the Authoring Server to provide for authoring services while the C-template and TS-template are associated with the Courseware Server for the composing of dynamic courseware (Fig.2).

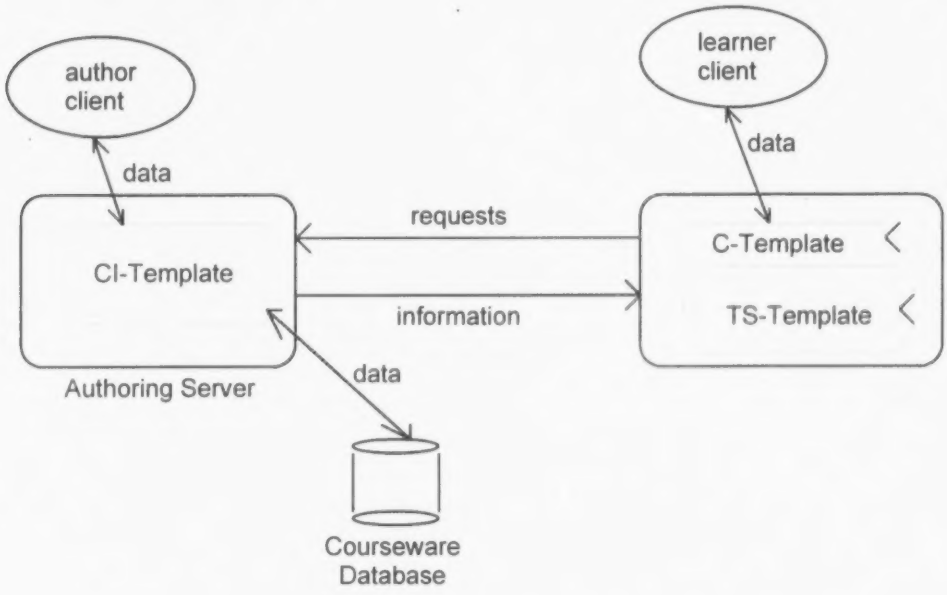

Fig.2: Working amongst the templates

With the CI-template, a standardized guideline or format is provided for the author to 'register' his/her teaching materials in the Web. As for the C-template and TS-template, they help the learner to specify his/her learning particulars so that more specific learning materials can be collected and collated for the courseware. Operating the templates essentially relies on some Java-procedures that carry out the interaction.

Implementation

The architecture components namely AS (Authoring Server) and CS (Courseware Server) and the associated template procedures have been experimentally implemented in a local server housed at the Hong Kong Polytechnic University. In order to facilitate its usage, all system procedures are implemented in Java except those related to courseware databases, which are essentially based on PERL (Practical Extraction and Reporting Language) as the CGI (Common Gateway Interface) script. Java-based and HTML interfaces are also used. Compiled Java applets, which are in the form of bytecode, can be run on any platform with Java's runtime environment present. In the implementation, Java applet is used for displaying the dynamically generated hierarchy of courseware. The applet is embedded inside the hypertext page and be viewed as a table of content page. Three different views are also organised for displaying Modules, Units and Topics. Besides, the implementation also allows users to browse through the table of content of the courseware in hypertext links with web site addresses shown.

Illustration

We have experimented the architecture by building an HTML (Hypertext Markup Language) courseware [Lemay's 1996]. Below we illustrate some of the functioning screens generated by the PERL scripts and Java procedures for developing the courseware (Fig. 3a and Fig. 3b) (with Oracle database used to support the courseware databases). The screens will not be explained as they are self-explanatory.

Fig.3a: Sample screen generated by CGI/PERL scripts.

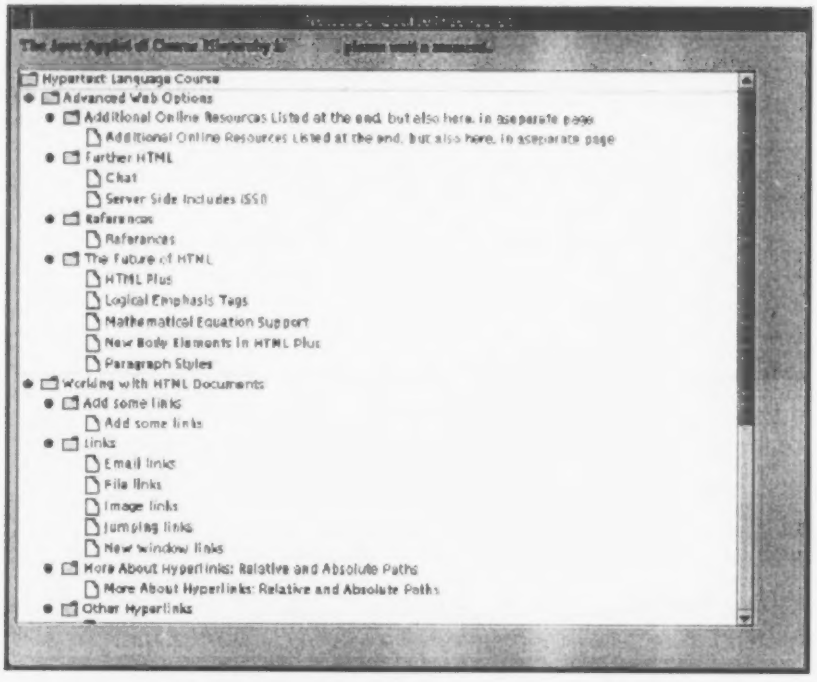

Fig.3b: Sample Java Applet showing course hierarchy.

Discussions

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Initial benefits perceived of the approach can be summarized as follows:

- Improvement in relevance of search results in the web.
- Dynamicity in fulfilling different users' needs.
- Efficience in distributing teaching materials.
- Standard web-based user interface.
- Good accessibility of courseware, moreover the approach is easy to use.
- Portablity, as the course is adoptable for multi platforms.

However, similar to others, we also experienced some limitations in our current work [Ibrahim 1997]. They are:

- Our current graphical user interface is limited by the primitive syntax of HTML. Nonetheless, such condition can be improved with the recent development of XML (Extensible Markup Language).
- We currently face some problems related to response time limitation due to heavy network load and server load. It is expected that with improvement in the Internet infrastructure (e.g. bandwidth, etc.) the situation can be alleviated.
- Statelessness of the HTTP protocol. This is a problem faced by the WWW community and is anticipated not easily be solved in the near future.
- In our implementation, we have yet installed any user model. Yet, for truly adaptive to individual, the incorporation of an appropriate user model is mandatory [Kok 1991].

With the recent development of XML (Extensible Markup Language), it is expected that the display aspects can be much improved. An improvement in the Internet infrastructure (e.g. bandwidth, etc.) can also help alleviate the situation. In addition, more visualisation techniques can be applied for the manipulation of templates to aid in the representation of the structure and relationship of courseware contents. Currently we are preparing to implement an accompanying agent to enable further exploitation of the architecture and its associated mechanisms for dynamic courseware generation. Although more significant result is yet to be seen, the endeavour nonetheless provides a simple yet effective means for building courseware from the pool of teaching materials in the web.

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Experiences with a Bilingual Hierarchical Regional Directory in Taiwan

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Abstract: This paper describes the experiences with the YamWeb server, the first and most popular directory engine in Taiwan. With the rapid increase of Internet servers, search engines are well known as useful tools for users to locate the information they need. However, most global engines are world-wide and English-based; there are several technical and cultural considerations for engines to serve non-English community. YamWeb tries to address these issues from the viewpoints of Taiwanese. It fully supports Chinese search and it can be extended easily to support cross-language search. Comparing with others, we show that YamWeb can discover more sites and pages than global engines. Besides, as a hierarchical directory YamWeb supports sub-domain functions for users to specialize their interests. It also catches the redirection hits to track the users and to discover the most popular sites. We found that 71.2% of the redirections are to access 10% of the YamWeb links, and about 80% of the local web pages are provided by 10% of the servers in Taiwan. More analyses are also presented in this paper.

A Web-based Real-time Cooperative Editor in Java

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Abstract: This paper describes a prototypical Web-based distributed real-time unconstrained cooperative editing (REDUCE) system, which has been designed and implemented as an experimental vehicle for our work on fundamental issues, such as consistency maintenance and concurrency control. The REDUCE front-end is implemented as a Java applet which enables team members to join a distributed real-time cooperative editing session by visiting the editor Web page and downloading the applet on the fly without necessity to install the software. In particular, the performance has been tested to conduct the evaluation of this real-time system.

1. Introduction

Real-time cooperative editing systems allow physically dispersed people to view and edit shared textual/graphical/multimedia documents at the same time. They are very useful facilities in the rapidly expanding area of CSCW (Computer-Supported Cooperative Work) applications, such as electronic conferencing/meeting, and collaborative design systems. Research into cooperative editors has been a popular topic in the CSCW community since mid-80s and many papers have been published in various CSCW related conference proceedings and journals [Ellis et al. 91, Zhang & Yang 94, Ressel et al. 96, Sun et al. 98]. The goal of our REDUCE (REal-time Distributed Unconstrained Cooperative Editing) research is to investigate the principles and techniques underlying the construction of the REDUCE system with the following three features:

1. *Real-time: The response to local user actions should be quick (ideally as quick as a single-user editor) and the latency for remote user actions should be low (determined by external communication latency only)*. The key performance is the response time seen by the user. Poor responsiveness limits the amount of work processed, so the performance plays a critical role in a system's effectiveness and productivity of its users. Many users subconsciously base their perception of (computer) service more on system responsiveness than on functionality. This phenomenon becomes more critical in a response-sensitive system like REDUCE.
2. *Distributed: Cooperating users may reside on different machines connected by different communication networks with nondeterministic latency*. The emergence and wide-spread adoption of the World Wide Web offers a great deal of potential for the development of collaborative technologies as an enabling infrastructure. According to [Oreizy & Kaiser 97], the Web, as enabling technology for software development and distribution, changes the fundamental assumptions ingrained in the discipline. In addition, the Java programming language, which has the capabilities of delivering applets over the Web as well as the claim of writing the code once and then running anywhere. All these encourage us to prototype our REDUCE system in Java in a Web-based environment.
3. *Unconstrained: Multiple users may concurrently and freely edit any part of the document at any time, in order to achieve free and natural information flow among cooperating users, as investigated in [Ellis et al. 91, Zhang & Yang 94, Ressel et al. 96, Sun et al. 98].* The reason why the unconstrained cooperative editing is proposed is that we strongly believe that too much restriction imposed on the users is one of the main factors why many CSCW applications fail as addressed by Grudin about one decade ago [Grudin 88]. There are also some similar work for supporting unconstrained cooperative editing such as [Ellis et al. 91, Ressel et al. 96].

In this paper, we give an overview of the inconsistency problems involved in the unconstrained cooperative editing in Section 2 to address feature 3. We then describe the Web-based REDUCE system in Section 3 to illustrate feature 2. After that, we present the performance measurement of the REDUCE prototype in Section 4 to address feature 1. Finally, we conclude our work and point out the future work in Section 5.

2. Overview of Inconsistency Problems

There are two different system architectures regarding the storage for the shared documents: the *centralised* versus *replicated* architectures. The centralised architecture uses a single site to save the shared documents and all updates to the shared documents are directed to this single site. Despite its advantages of simplicity and easiness for consistency maintenance, a serious drawback of the centralised approach is its poor responsiveness and great latency in the Internet environment. In contrast, the replicated architecture has the shared documents replicated at the local storage of each participating site, so updates are first performed at local sites immediately and then propagated to remote sites. We have adopted the replicated architecture for its quick responsiveness and for its robustness with respect to site crashes. One of the most significant challenges in designing and implementing real-time cooperative editing systems with a replicated architecture is concurrency control to maintain consistency of the replicated documents under constrains of a short response time, a short notification time, and unconstrained collaboration in the Internet environment.

Allowing unconstrained cooperative editing with a replication architecture of storage immediately results in complicated inconsistency problems. Because of concurrent generation of operations and nondeterministic communication latency, there exist three major inconsistency problems: (1) *divergence,* (2) *Causality-violation,* (3) *Intention-violation* [Sun et al. 96, Sun et al. 98]. The absence of concurrency control in a real-time cooperative editing system could lead to inconsistencies in the final results of shared documents, as well as in the group users' mental model about what is actually going on in a cooperative editing session. It is worth pointing out that apart from the above *syntactic* inconsistency problems, there are still other *semantic* inconsistency problems, which cannot, and should not, be solved by underlying concurrency control mechanisms [Zhang & Yang 94]. We view this as a group cooperation problem, rather than a concurrency control problem, which can only be solved by external social protocols rather than internal technical protocols.

The REDUCE consistency model and the comparison to other systems have been detailed earlier in [Sun et al. 96, Sun et al. 98] which has three properties: convergence, causality preservation and intention preservation. In essence, the *convergence* property ensures the consistency of the final results *at the end* of a cooperative editing session. The *causality-preservation* property ensures the consistency of the execution orders of dependent operations *during* a cooperative editing session. And the *intention-preservation* property ensures that the effect of executing an operation at remote sites achieves the same effect as executing this operation at the local site at the time of its generation, and the execution effects of independent operations do not interfere with each other. In this paper, we focus on the other two features, i.e. a Web-based prototype and responsive performance in next sections.

3. REDUCE Prototype

The prototype has been implemented to realize the REDUCE consistency model we proposed to support unconstrained cooperative editing in a distributed environment in general and a Web-based environment in particular. The consideration of real-time responsiveness has been taken into account in implementation as addressed in this section and further verified by performance evaluation in the next section.

3.1 System Architecture

A REDUCE system consists of multiple cooperating REDUCE *sites*. Each REDUCE site is typically a PC machine or a workstation, with user interface facilities for displaying shared documents and for generating editing operations, local storage facilities for storing replicates of shared documents, and computing and communication facilities for executing, synchronizing, and propagating editing operations. The REDUCE end-user related software is a signed Java applet, when downloaded, running locally as a cooperating site called REDUCE *Site Server* (SS). In addition, a centralised REDUCE *Session Manager* (SM), a Java application running as a daemon, is used to implement protocols for cooperating membership and session management. The SM is not involved in executing/propagating editing operations, rather, it is only contacted when a user joins or leaves a session. The reason for using this strategy is for improving the performance. With direct communication among SS sites for multicasting editing operations, rather than via the SM, the network latency will be reduced to the minimum. In effect, the SM is replicated in the prototype to enhance the reliability in order to tolerate

single SM site failure. The REDUCE system consisting of a replicated SM and three REDUCE SS sites is shown, see [Fig. 1]. The major components inside the SM and each SS are explained in Subsections 3.2 and 3.3.

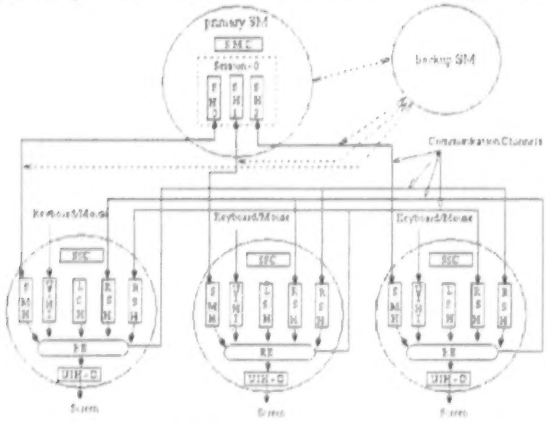

Figure 1: REDUCE architecture and components

3.2 Fault-tolerant REDUCE Session Manager

The SM is implemented as a Java application, running as a daemon, see [Fig. 1]. It has a Session Manager Connector (SMC) component waiting for connection requests when the REDUCE Java applet is downloaded. Once a connection request is accepted, the SMC creates a new thread, called Site Handler (SH), to handle further communications between the REDUCE site and SM. For each cooperative editing session, SM maintains a *Session Table* (ST) with one entry for a potential REDUCE site. When a new connection request arrives for joining an existing session, SM searches the corresponding ST for a free entry, allocates the free entry's index to the new site as its session identifier, and creates an SH to handle further communications with the new site. When a REDUCE site leaves a session, the corresponding ST entry will be reclaimed.

The SM plays a central role in editing session management for looking after joins and leaves of team members. With the session manger running on a single site, if it is down, no new team member can join the cooperative editing session and no proper notification can be informed to other members regarding the leave of any exiting team member. To increase REDUCE reliability in a distributed environment, i.e. the Internet, we have attempted to use a variation of the primary-backup model to tolerate the single failure of servers, see [Fig. 1]. The twin servers, which normally locate at different sites over the Internet and connect to each other via twin listener and connector threads, can dramatically reduce the failure rate of the SM. In our case, if the primary SM site is down, the backup SM site will replace the primary site to manage the editing session and vice versa. This implies that the SM is down only when both primary and backup SM sites are down which has a much lower failure rate than a single SM site.

3.3 REDUCE Site Server

The SS is implemented as a Java applet to be downloaded by any team member to join an editing session. To incorporate the security restrictions for Java applets, we have implemented the SS as a signed applet to allow local file system access etc since some documents may well reside, say on the local Web servers, which can be easily accessed by team members with the underlying Web support. The Java security model is still evolving and we shall deploy the new appropriate features when available. The REDUCE system now can run on a Java 1.1 virtual machine such as HotJava and the Java JDK 1.1 appletviewer. When downloaded, the SS will contact the SM - the twin servers - to make connection with other team members in the same session and thereafter will be notified by the SM with any team member who joins or leaves the session, see [Fig. 1]. The SS has been implemented to enable switching over automatically between the primary and backup SM sites if the currently serving SM site is down.

The SS consists of the following major components: (1) a Session Management Handler (SMH) - a thread inside the SS process to handle all messages related to the SM; (2) a Site Server Connector (SSC) - a thread responsible for accepting connection requests from new REDUCE sites and creating a new Remote Site Handler

(see the next item) for each new connection; (3) multiple Remote Site Handlers (RSH) - concurrent threads corresponding to multiple remote sites in the current cooperative session. Each RSH is responsible for receiving messages from the corresponding remote site. An RSH may be created by the SMH thread if the local site is newly joined, or by the SSC thread if the local site is an existing site; (4) a Local Site Handler (LSH) - a thread responsible for handling some miscellaneous issues, such as the local timers for flushing the input string buffer and for multicasting local status messages to remote sites to facilitate garbage collection if the local user has been silent for certain period of time; (5) a User Interface Handler (UIH), which runs inside the main thread of the SS process and implements the local graphics interface. This component is conceptually divided into two parts: one is the UIH Input (UIH-I) for handling input events generated from the local keyboard and mouse, and the other is the UIH Output (UIH-O) for handling requests (from the REDUCE Engine (RE), see the next item) for updating the local editing window (i.e. the shared document state); and (6) a REDUCE Engine (RE) - the central component shared by all other components inside the SS process. The RE implements the REDUCE distributed concurrency control algorithms, takes care of communication with remote SS, and provides a synchronised point of access to the local UIH-O and other local site status information by multiple concurrent threads (i.e. RSHs, UIH-I, LSH, and SMH) inside the SS process. The RE is implemented as a monitor, so there can be only one active thread inside it at any instant of time.

Since the REDUCE editor is Web-based for real-time cooperative editing across the Internet, for improving the responsiveness, we have imposed the following strategies: (1) REDUCE uses the character-wise strategy for the local editing operations so that the local user can see the editing effect immediately; (2) the local editing operation thread has higher priority than threads for processing the remote operations so that if there is a queue of incoming remote editing operations, the local editing operation will wait for maximum one remote operation processing; (3) REDUCE uses the string-wise strategy for multicasting editing operations to the remote sites so that network communication is carried out in a buffered manner to reduce as much communication overheads as possible; and (4) as indicated earlier, REDUCE adopts the mechanism of direct network communication among the cooperating sites to reduce the network latency to the minimum.

3.4 REDUCE System in Action

Figure 2: The screendump of the Reduce prototype

The Java applet of SS has been implemented in two different ways: one embedded within the browser window and the other as a pop-up window. The screen snapshot, see [Fig. 2], depicts a REDUCE text editor adopting the former. It is based on using the Sun HotJava Web browser to invoke the REDUCE editor via the URL which shows: (1) the text editing panel which allows team member to edit the document without any constrains, i.e. editing at any position of the text and at any time; (2) some illustrative buttons for file access and editing operations of cut, paste and copy etc to enable the team members to prepare a passage of text in a private window before put it in the shared editing panel; and (3) a display panel to indicate the connected sites. The buttons over the right-hand side are for testing which are not important to a real editing session. It is only used for REDUCE prototype testing in order to set up artificially the network delays at different sites and initiate various combinations of consistency preservation properties and so forth.

Since the REDUCE system is implemented in Java and according to the claim "write once and run

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anywhere", it can run on a wide range of platforms as long as the standard Java 1.1 virtual machine is supported, such as Windows 95/NT and Sun Solaris. However, some bugs have been noticed in some Java virtual machines which have been confirmed to be fixed in the future releases. In addition, the user only needs to visit the REDUCE Web site to download the Java applet of the editor on the fly in order to join the real-time cooperative editing session. This implies that no software needs to be installed on the users' local system.

4. REDUCE Performance Evaluation

The initial performance tests were measured on a Sun Workstation running Solaris 2.6 with a 100MHz CPU to verify whether our strategies adopted in Section 3 are effective. We represent the raw data from our experiments, see [Tab. 1], showing the CPU time consumption in direct response to related Java methods executed for processing editing operations. The time measured is to accuracy of milliseconds and is the average time based on at least 20 tests for each case. Each specific time interval is measured by recording and subtracting two CPU running times immediately before and after the related task(s). For example, for a local insert, the CPU time consumption is the processing time starting from the key press event to that the character being displayed on the screen. The performance tests were conducted for processing local and remote operations for insertion and deletion.

REDUCE performance	(string-wise) string length	CPU-time	character-wise	CPU-time
remote insert	1	0.038 sec.	local insert (single character)	0.011 sec.
	10	0.039 sec.		
	50	0.044 sec.		
remote delete	1	0.036 sec.	local delete	0.018 sec.
	10	0.036 sec.		
	50	0.037 sec.		

Table 1: Raw data of REDUCE performance

The ultimate goal for responsiveness, as we indicated in Section 1 about the features of REDUCE, is that the response to local user actions should be quick (ideally as quick as a single-user editor) and the latency for remote user actions should be low (determined by external communication latency only). Given the strategies described in Section 3, clearly, with string-wise multicasting and direct communication, we reduce the communication overheads as low as possible. Since network latency is very much beyond the control of our REDUCE system, in performance evaluation, we focus on responsiveness at a local site of how quick to process local operations and an incoming remote operation.

In REDUCE, since a remote operation is based on the string-wise strategy, we decided to measure various string lengths of 1 character, 10 and 50 characters (and normally the string length will not exceed 50 characters anyway). In general, they are fairly consistent with the CPU-time consumption of only around 0.04 seconds for local processing as indicated in [Tab. 1]. In other words, the string-wise strategy is very effective. For example, take the 10 character case, if it is character-based, it would consumes CPU time of around 0.4 seconds instead of 0.04 seconds in a string-wise case which is just for local site processing time increase only. In effect, the Internet communication cost for the string-wise strategy will also be much more effective than the character-based multicasting.

Since the local user normally cannot tell when an incoming remote operation will happen, the responsiveness is not as critical as that of a local operation. For local operations, the team member needs to see the editing effect immediately. In general, if the response time is less than 0.1 seconds or 100 milliseconds, it is barely noticeable by the user [Broom87]. According to performance measured, see [Tab. 1], on average, the CPU time consumptions for local single character insert operations and normal delete operations are about 0.011 and 0.018 seconds, well below 0.1 second mark. Even in the worst case that there is a queue of incoming remote operations, since the local operation thread has higher priority, it only needs to wait for completion of one remote operation processing, that is around 0.04 seconds. In total, the CPU time consumption will be around 0.05 seconds, still well below the 0.1 second mark. However, if we did not have the prioritised threading strategy, suppose there are three incoming remote operations in the queue, the response time to the user for the local operation would be well above 0.1 second mark which may very likely be noticeable. In [Tab. 1], it is interesting to see that the local delete time is longer than the local (single character) insert time. The reason is that the delete operation needs to save/record the text string to be deleted for the purpose of "undo" while the

insert operation has already had the record of the inserted text/character. It is the same case for remote delete operations to save/record the deleted strings, but it is not a dominating processing time consumer there.

Based on our performance evaluation described above, we conclude that REDUCE is response effective for both local and remote editing operations to achieve the real-time feature of REDUCE as addressed in Section 1. It also verifies that our strategies described in Section 3 are effective to achieve the real-time performance we try to achieve.

5. Conclusions and Future Work

In this paper, we have described our prototype in the context of the REDUCE (REal-time Distributed Unconstrained Cooperative Editing) project. It offers a fault-tolerant session manager and a Web-based user interface for distributed real-time cooperative editing across the Internet, and particularly the performance evaluation has verified our implementation strategies to deliver real-time responses. The system is based on the REDUCE engine which solves inconsistency problems involved to support unconstrained cooperative editing. With the Web/Java approach, we can dramatically reduce the costs and delays associated with distributed information; provide up-to-date (Internet-based cooperation) software like REDUCE without local installation; and offer a simple, extensible and standard (platform-independent) environment.

The wish list for the future work is long. For example, immediately additional work can be on fault-tolerance for the REDUCE site server and more intensive performance evaluation. Certainly, we also need to add more functionality for both editing activities. To enable better group awareness of a cooperative editing session, we plan to implement more widgets in this regard and an audio channel for more effective group communication among team members. We clearly need to investigate how to utilize REDUCE further in the Web environment. Moreover, under a big umbrella, we are working on Web-based global teamwork support where REDUCE is facilitated as an integrated tool.

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Mechanisms for Web-based Visualised Teamwork Support

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1. Introduction

Nowadays, there is a growing interest to support cooperative work over the Internet and the Web. The emergence and wide spread adoption of the Web offers a great deal of potential for the development of collaborative technologies as an enabling infrastructure. According to [Oreizy & Kaiser 97], the Web, as enabling technology for software development and distribution, changes the fundamental assumptions ingrained in the discipline. In addition, the Java programming language, which has the capabilities of delivering applets over the Web as well as the claim of writing the code once and then running anywhere, has encouraged us to prototype our framework in Java, based on the Web environment. In this case, no particular (up-to-date) software needs to be installed for (client-side) team members since Java applets can be downloaded on the fly and then run directly. Moreover, using combination of Web/Java seems better than using Web/CGI (common gateway interface) [Evans & Rogers 97] in the sense of performance and control/data granularity. Therefore, we have treated the Web and Java as an excellent, if not ideal, vehicle to prototype our teamwork support mechanisms in a global distributed environment.

Teamwork is a key feature in any workplace organisation. Developers of large systems normally spend 70% of the time working with others. Particularly, in this computing era, many (non-trivial) tasks are normally carried out by team members, who may physically dispersed, by using various (software) tools. Systems for computer-mediated teamwork, groupware or computer-supported cooperative work (CSCW) offer various automatic supports for team cooperation to improve the productivity. In [Yang 98], we indicate that our DWebTeam project has the following characteristics: (1) effective teamwork coordination with strong task evolution and resource management support; (2) seamless integration of team communication and collaboration; (3) entirely Web based; and (4) provision of a visual environment. In this paper, we focus on general mechanisms about providing visulised support for defining teamwork (i.e. modelling) and managing teamwork (i.e. coordination) in a Web-based environment. To deploy teamwork support tools broadly, especially to non-computer professionals, it is critical to provide an easy-to-use user interface for teamwork managers, who are in charge of process modelling, and team members, who are the people to carry out the teamwork coordinated by the tools. In this regard, it is vital to develop a visualised intuitive user interface for both teamwork managers and team members.

2. Requirements and Mechanisms for Visulised Teamwork Support

Generally speaking, a task, also called a process or a project, is normally composed of partially ordered sub-tasks [Feiler & Humphrey 93]. By partial ordering, it means that a sub-task should and can only start when its previous sub-tasks have been completed. A practical environment should support visual programming to model the teamwork without knowledge of the underlying technology as well as a friendly user interface to facilitate teamwork. We are implementing this kind of visual environment in Java at the moment for DWebTeam. The final environment should enable teamwork managers to visually specify such as tasks, team members, documents, tools, start/finish dates and other components involved in the teamwork for modelling the project which can then be carried out by team members via the Web.

For a team member, it would be very useful to have a global view of the project in a visualised fashion in order to create a better teamwork atmosphere, which is important from the psychological point of view when a person works in a computer-mediated teamwork environment. More importantly, a team member should be provided an up-to-date *to-do* list, say via a Java applet, ideally with sensitive indicators for deadlines and other information for the work to be done. The team member can then use local tools or tools available in the teamwork environment, to carry out the work. When a certain sub-task is finished, a notification should be able to be sent easily to the teamwork support environment, say simply via a button click, to notify the environment to adjust the global teamwork view and generate new to-do lists for all affected team members.

For a teamwork manager, especially a non-computer professional, it would be extremely difficult and

perhaps just impractical to use a conventional computer (modelling) language to specify a project. Given the exposure of window-based environments, it is increasingly demanding and important to provide intuitive visual programming environments to support teamwork managers to specify projects. A practical teamwork support environment should be designed to support visual programming to model the teamwork-based project. This is the primary focus of the visulised programming or modelling environment in our work.

There are various mechanisms to visualise the workflow of a project such as the well-known PERT and Gantt charts and their variations. One typical example is ActionPlan [Ly 97]. However, for teamwork modelling, most environments only support the flat bottom level view of projects. We argue that teamwork modelling itself is often a process of decomposition. It is more natural to model a project at a high level first and then to have a further view of high level components. This process may continue until the bottom level. We propose the visualisation mechanism which offers zooming to enable project managers to model the project more effectively and to offer different team members with various and more appropriate levels of project views.

With handling individual sub-tasks and their ordering, the drag-and-drop user interface, say via a Java applet, is essential to allow a teamwork manager to visually specify the ordering and assign various components to sub-tasks. Those components may include (constraint) resources like team members, documents, and hardware/software based on their availability with the certain times/dates/deadlines. An automatic/semi-automatic resource management support for the manager, as we initially addressed in [Yang & Ni 97], would be very constructive which should be in a visualised fashion to display available resources in the resource pool for the sub-task. Meantime, given that any project is a living thing with (inevitable) changes in the life-cycle of the project, it is very important to have evolution support for project managers.

We use the milti-tiered client-server architecture for Web-based teamwork support. It includes clients as front-ends using downloaded Java applets (for managers and team members), local tools and Web servers, centralised servers with tools, and supporting tools such as databases as back-ends. For the information repository, at the first place, we use the Java JDBC interface to connect to Oracle (can be other relational databases without changing the Java code). In effect, JDBC is a low level middleware tool that provides the basic features to interface a Java application with a relational database. We now plan to use ObjectStore, an object-oriented database, so that we can handle objects directly.

3. Conclusions and Future Work

In this paper, we have addressed the importance of Web-based teamwork support to be realised by a visual environment to enable non-computer professionals to use in practice. Corresponding mechanisms are briefly addressed to visually support both teamwork managers to model the teamwork and team members to carry out the teamwork. Currently, we are prototyping such a visualised environment in Java to support teamwork.

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Challenges and Pitfalls of WEB-Based Learning

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Abstract: Technology is perceived by many to be a means to lower the costs of education and extend educational boundaries. The use of the World Wide Web to enhance and extend the classroom is growing. Thus, it is important to debate the many issues that impact the educational value of WEB-based opportunities. The panelists will demonstrate some powerful ways in which they have integrated technology into their classrooms. Although each panelist feels that technology used to support educational goals has been overall successful, they agreed that their experiences have not been without challenges and problems. The panel members will demonstrate their use of technology and discuss issues.

Introduction

Educational institutions, victims of escalating costs and public scrutiny relevant to education, have recently concentrated on ways to present quality education using the World Wide Web (WWW) for instructional purposes. Technology is perceived as a way to lower costs of education, extend education beyond the physical bounds of the classroom and, at the same time, provide a mode of instruction that can effectively increase retention and provide interaction. These outcomes are well supported in the research.

However, change is never effortless nor without challenge. The challenges of Web-based education place different demands on university administration and educators and new expectations about their roles. Concerns by various constituents regarding the successful implementation of Web-based educational opportunities are rampant. The panelists, each a forerunner of educational change and challenge, will address and debate issues surrounding the integration of WEB-based technologies.

Specifically, panelists will discuss reasons for considering new educational opportunities. For instance, in some cases students must frequently travel from dispersed communities to attend classes or students work either part-time or full-time in addition to having family obligations. Given these constraints and characteristics of a growing *nontraditional student population*, it is difficult for students to attend classes or collaborate outside of the classroom and thus, to reap the benefits offered from a collaborative learning environment. In other cases, it is felt that there is a need to expose students to the world of virtual collaboration to better prepare them for corporate life in the 1990s and beyond. Finally, the panelists collectively believe that the WEB offers opportunities that challenge students and thus increase the value of educational experiences.

The issues faced by those on the "front-line," i.e. educators themselves are often the reason for consternation on the part of educators and the focus of this panel. For instance, faculty members have who approached technology integration with enthusiasm subsequently report that some students are apprehensive and uncooperative. Issues cited range from that of grading, the metamorphous brought about by the new ways in which teachers interact with

students, and pedagogical issues. Realistically, panel members agree that technology per se is not the real issue; rather, it is the manner in which we integrate the technology and the way in which we use it.

The burden of effectively dealing with the complexities and uncertainties associated with new technologies and ensuring the smooth integration of these technologies invariably rests on the shoulders of educators. The participants of this session all have a history of using the WEB to support and enhance the learning process. Experience ranges from traditional classroom support to computer assisted learning and collaborative techniques enhanced by computer conferencing. Although each panelist is convinced that his/her experiences have been beneficial, they readily admit that using WEB-based technologies have brought about a bevy of problems which they will debate as part of this panel.

Panelists

Rachelle Heller. Interim Associate Dean for Academic Affairs and Professor.

Dr. Heller brings with her a wealth of experience in bringing technology into the Computer Science classroom. She has developed and will discuss a series of models for including technology into the CS curriculum. Examples of simple web-based materials such as support for syllabii and assignments to chat rooms to demonstration software will be offered. Dr. Heller has determined that there is a place for WEB-based instructional support and has proven that it can be accomplished smoothly and with success.

Specifically, Dr. Heller will share her experiences in a course on electronic commerce. This course uses the WEB intensively for syllabus, lecture notes, readings, resource listing, and student communication. The thrust of this discussion will be how to create and manage web sites using student support. Of course, as with anything else, there are pitfalls to avoid and these will be debated.

Rosalie Ocker. Associate Professor of Information Systems. Dr. Ocker will discuss her experiences with computer conferencing as a means to support collaborative learning. As teams are the basic organizing structure used by firms to accomplish work, a key competency of the information system (IS) professional is the ability to work in teams. Skills relating to effective collaboration -- analytical skills coupled with creative problem solving and effective communication among groups of decision makers -- are viewed as critical to the successful IS professional. For this reason, the IS curriculum incorporates collaborative learning techniques which promote both effective collaboration and effective learning.

A computer conferencing system (i.e., FirstClass) has been incorporated into various courses in both the undergraduate and graduate curriculum to support a collaborative environment. Dr. Ocker feels that using computer conferencing technology provides many benefits to students and that critical issues fall predominantly into two categories: (1) course design and (2) technical support.

Course Design Issues include:

1. How to design effective collaborative assignments to incorporate the use of computer conferencing
2. How to best reallocate class time in terms of in-class meetings versus out-of-class (i.e. conferencing) meetings
3. How to design courses to incorporate both in-class collaboration and computer conferencing collaboration
4. What additional support does the instructor need to include computer conferencing
5. What is the best method of creating collaborative groups in this environment

Technical Support Issues include:

1. How to ensure that all students have easy access to the computer conferencing technology, in an environment where not all students own a PC with a modem.
2. What support is needed in terms of running the conferencing hardware and software
3. What support is needed to help students who are experiencing technical difficulties

Sorel Reisman, Professor of MIS and Coordinator of Academic Technology.

Institutions of higher education often fail to offer students and faculty Web-based information and instructional tools and for this reason, many facilities are at serious competitive disadvantage in terms of student and faculty recruitment. While most colleges and universities recognize the need to have a Web image and presence, fewer have made a committed effort to make their sites into truly useful resources consistent with the instructional and research goals of their institutions. Obstacles towards moving forward can be numerous and will be debated by Dr. Reisman.

One of the more difficult obstacles to deal with is higher education's apparent need to debate and reach consensus upon every manner of detail regarding institutional missions and goals and their potential relationship to the form and content of a web site. Another and more practical issue is the absence of widespread experience regarding the kinds of resources to even to make available on such web sites. Despite such issues, many institutions are moving forward, ignoring academic debates and breaking new ground in developing virtual learning/instructional environments for any full-time, part-time, or even "no-time" learner who has access to the World Wide Web.

Gayle J. Yaverbaum, Director of Graduate Studies and Associate Professor of Information Systems .

Dr. Yaverbaum's experiences extend from WEB-based classroom support materials such as syllabi and assignments to developing and using WEB cases and integrating collaborative opportunities via computer conferencing. Dr. Yaverbaum has experimented with a variety of techniques and readily admits that new methods of learning are often plagued with student resistance.

The focus of her remarks will relate to WEB-based cases in which students collaborate over the WEB and solve inherent problems. Cases include interactive exercises and discussion groups via computer conferencing. Issues include:

1. Design of WEB-based cases
2. Integration of active learning on the WEB
3. How best to work with teams
4. Grading
5. Instructor role

Dr. Yaverbaum believes that benefits of collaboration and active participation by students far outweigh the difficulties encountered.

Summary

Issues that will be debated are student preparation and course design. It is critical to structure WEB-based opportunities such that educational objectives are met. Many educators are eager to produce technology-based

educational material but fail to first define clear objectives. It is no wonder that students are not challenged, fail to feel a sense of accomplishment, and see little value in the exercise.

Problem Solving in the Virtual Classroom: A Study of Student Perceptions Related to Collaborative Learning Techniques

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Abract: Collaborative learning is receiving increasing attention within educational environments. With increasing use of technology to support collaborative techniques it is critical that existing research in this area is expanded. This study was initiated to examine and explore the perceptions of students relative to experiences within two types of problem solving teams - one with a technology supported collaborative environment and the other without such support. Rankings related to prior attitudes about collaborative work-related issues and post-perceptions related to quality of discussions, satisfaction with the group process, and satisfaction with outcome were collected using a survey instrument containing Likert-scale statements. The data was analyzed using correlations between prior attitudes and the aroremented post-perceptions.

Introduction

A major shift in learning, the locus of which is increasing attention on constructivism, is being integrated into traditional and distance learning environments. The constructivist paradigm has been described as focusing on learner-centered instruction (Leidner and Jarvenpaa, 1995), discovering conceptual relationships, exploring multiple representations and perspectives, and/or immersing the learner in the real-world context in which learning is relevant (Jonassen 1993).

Collaborative learning, a technique that supports the principles of constructivism, involves small groups of students working together to solve assignments. This concept is described by Whipple (1987) as including 1) an active role by both teachers and learners, 2) the culture of the learning environment, and 3) the view that knowledge is not transferred from expert to learner, but rather created and located in the learning community. The value of teamwork in learning is well supported by Alavi (1994) who explains that this kind of learning extends cognitive activity and team members are able to monitor individual thinking, opinions, and beliefs providing feedback that results in clarification and change. Alavi believes that cooperation and teamwork foster social support and encouragement and therefore support learning by problem solving, a means to extend, test, and refine mental models until they are both effective and reliable.

Although same-time, same-place, synchronous learning techniques have been the norm for collaborative experiences for many years; the integration of technology within the academic community has expanded the possibilities of collaboration to include students who are not physically in the same location. Thus, any-time, any-place, asynchronous learning has created new opportunities for students and is a technique associated with distance education. Distance education is described by Verduin and Clark (1991) as a formal approach to learning in which most instruction occurs while educator and learner are a distance from each other. Included among the numerous reasons for providing distance opportunities are:

1) people who need to learn together are scattered over broad areas,
2) people who need to learn are restricted in the times they can devote to learning,
3) face-to-face experiences are simply becoming too costly, and

4) face-to-face experiences do not cater to diversity.

Computer-supported collaborative work is the term applied to how people work together online despite being separated by space and in time (Hiltz and Wellman, 1997). Morrison (1994) relates computer conferencing to collaborative techniques and distance options and describes computer conferencing as an asynchronous method in which students can keyboard comments outside of class and at their own convenience. He emphasizes that conferencing facilitates the debating of issues, clarifying of concepts, and the asking of questions as part of a collaborative community. Hiltz and Wellman underscore the idea that computers support social networks formed by linking people as well as machines. Conferencing technologies are said to facilitate the extension of concepts beyond the typical classroom, offering unique opportunities for students to be part of a community of practice (Bonk, Appleman, and Hay, 1996). Morrison (1994) views computer conferencing as a means of providing a forum for students who may ordinarily refrain from discussion and he sees the technology as supporting spontaneous problem-solving which results in a new dimension to applying prior learning.

Other benefits reviewed by Berge and Collins (1993) include professional growth, convenience, independence of time and distance, and the removal of participation barrier. There is evidence that electronic classrooms may induce student interaction (Bump, 1990; Slatin, 1990). Hiltz (1989) would agree and notes that the virtual classroom creates more communication among a learning group as opposed to the more typical teacher and student communication found in many classrooms. While these benefits are a draw, Berge and Collins also review limitations such as learning curves, lack of social cues, access requirements, and hardware constraints. The lack of non-verbal cues might diminish "social presence" (Short, Williams, and Christie, 1976) and communication content may cause a sense of depersonalization (Hiltz, 1989).

Against this backdrop, educators must consider consequences from extending collaborative experiences via technology. We describe a setting in which collaborative is integrated and analyze student perceptions in two distinct situations:

1) same time/same place (synchronous) conventional classroom context, and
2) a computer conferencing virtual classroom whereby students participate any time/any place (asynchronous).

The purpose of this study is to identify predominant issues that emerge as we extend collaborative opportunities across distances.

The Research

Eighty-three students, enrolled in an upper-level, undergraduate class in programming or in a graduate course in the management of information resources, participated in the experiment. The tasks are best defined in terms of decision-making and problem-solving. Thirty-seven students were asked to develop a computer program assigned as part of course requirements in object oriented programming. The principles underlying object oriented programming are those that encompass any problem-solution environment, i.e. discussion of the problem and developing a solution. Forty-six students were asked to participate in a case problem using the same conceptual principles.

Projects were designed such that students were required to interact on a regular basis. Every participant knew that subsequent peer and instructor evaluation impacted his/her project grade. All subjects worked collaboratively to achieve a goal - in the former case a completed program and in the latter case, an analysis of the case and recommendations. First Class, ©SoftArc, Inc., computer conferencing software supported asynchronous team communication.

Two concurrent experiments were conducted. Subsequently, two additional experiments were conducted with teams reversing treatments. The treatments, each using collaborative techniques, were:

1) computer conferencing teams primarily using asynchronous communication and
2) face-to-face teams incorporating only synchronous communication.

Students, based upon background in computers and observed level of competency by the instructor, were assigned to teams varying in size from three to five persons. Thus, we presumed the teams to have mixed backgrounds both educationally and skill wise.

Specifically, the study analyzes perceptions of students with regards to quality of discussions, satisfaction with the group decision-making process, and satisfaction with the quality of outcomes. The results are compared among the two aforementioned collaborative techniques and also to student preconceptions about the value of teamwork, peer evaluation, task accomplishment, and comfort level working in a group. Background variables such as age, sex, student level, professor, and computer literacy were also analyzed and compared to post-experiment variables.

Two versions of the experimental task, both with similar difficulty, were administered to the students, yielding a 2 X 2 factorial design. This research design indicates that the subjects each had a chance to solve similar problems both synchronously and asynchronously. A majority of participants, 42 percent, were between the ages of 23 and 30. Another 39 percent were over the age of 30. All participants were either in the last two years of undergraduate study (28) or were engaged in graduate work (55). These facts are significant because they suggest an overall mature population.

We used two survey instruments to obtain the data. One instrument, administered prior to the experiment, was designed to capture student perceptions regarding the value of team collaboration, the effectiveness of tasks accomplished through collaborative efforts, the effectiveness of peer evaluation, and the comfort level working within groups. The second instrument, administered after the completion of each programming project or case, was used to acquire knowledge regarding student perceptions about the actual team experience. Rankings covered quality of the process, satisfaction with the process, and satisfaction with outcome.

Three definitive scales were examined in posttest rankings:

- Subjects' perceived quality of the discussions, recommendation, and solutions (Gouran, Brown, and Henry, 1978),
- Subjects' perceived satisfaction with the process used to reach a solution (Green and Taber, 1980), and
- Subjects' perceived satisfaction with the outcome/solution (Green and Taber, 1980).

Results

Table 1 shows that there are significant differences between the means of the two groups of students. The differences, however, are in the first two categories, i.e . quality of discussions and satisfaction with the process itself.

Dependent Variable Face-to-Face	Probability > F	R Square
Discussion Quality	.0534	.3931
Satisfaction with Process	.0001	.5774
Satisfaction Quality of Outcome	.2346	.2625

Table1: Comparison of Means - Face-to-Face and Computer Conferencing

Quality of discussions, satisfaction with the process, and satisfaction with outcomes were analyzed within each group using correlation analysis. The results, shown in Table 2, are presented below.

	Team Coll.	Peer Eval	Task	Com-fort	Lit	Age	Sex	Prof	Stud
Synchron.									
Discussion Quality	.570 .000*	.024 .832	.226 .040	.340 .002	.030 .786	.059 .608	.002 .988	.105 .344	.124 .264
Satisfaction Process	.510 .000*	-.006 .960	.259 .018	.344 .001	-.104 .351	-.018 .880	-.097 .396	-.099 .371	.084 .450
Satisfaction Outcomes	.356 .001	-.003 .980	.070 .534	.099 374	-.111 .320	.055 .640	-.086 .452	-.035 .757	-.033 .767
Asynch .									
Discussion Quality	.113 .313	-.120 .281	.171 .124	.083 .457	.013. 910	.057 .625	.087 .450	.065 .560	.049 .664
Satisfaction Process	.118 .313	-.171 .139	.170 .142	.195 .092	.048 .679	.143 .237	.173 .146	.000 1.00	.012 .918
Satisfaction Outcomes	.063 .596	.089 .449	.023 .842	.092 .433	-.004 .971	.028 .822	.067 .576	-.090 .445	.090 .445

Table 2: Correlation Analysis

Face-to-Face (Synchronous) Results:

1) There was a significant correlation between face-to-face post-test variables and pre-test feelings about the effectiveness of team collaboration.
2) There was also a significant correlation between pre-test feelings about task accomplishment and the post-test variables of discussion quality and general satisfaction with the problem-solving process.
3) Comfort level is positively correlated with discussion quality.
4) Interestingly, background variables of age, computer literacy, sex, student type (graduate or undergraduate) or professor are not significantly correlated with the results.

Computer Conferencing (Asynchronous) Results:

1) There were no significant correlations found between pre-test preconceptions about groups and the data collected as part of the post-test rankings.
2) The background characteristics reported by students, as with face-to-face method of problem solving, were not found to be correlated with post-test perceptions.

Summary and Conclusions

Students enrolled in information systems classes participated in an experiment whereby differences in attitudes towards collaborative learning were observed within two different learning environments - asynchronous and synchronous. Our conclusion is that significant differences exist that relate to the process by which problems are solved.

Distance and asynchronous opportunities, associated with computer conferencing, improve the perceived quality of the problem solving process and satisfaction with that process. There was a lack of differences associated with satisfaction of outcomes, which was initially surprising especially in light of the process variable results. However, upon further reflection, we believe the computer conferencing environment may provide more time than face-to-face environments for analysis and reflection. This supports the work of Alavi (1994), which attributes the extension of cognitive activity and ability to monitor individual thinking, opinions, and beliefs to computer conferencing. It should be noted that discussions and process are tied to interaction and in a face-to-face environment social cues are influential. The reduction of social pressures, referred to by Hiltz and Wellman (1997) as "reduced social presence," may very well be why these results have occurred.

Satisfaction with the quality of the outcome does not significantly differ among the research treatments. This is consistent with studies of distance education that repeatedly indicate that cognitive achievement of distance learning students is comparable with that of traditional classroom students (Barker and Platten, 1988, Ritchie and Newby, 1989). Several observations are relevant. First, outcome satisfaction is a result of the decision process and second, output is an end product that is graded. Thus, the process by which one solves a problem is separate and unique from the outcome.

Correlations between face-to-face pre test variables, i.e. feelings about the value of team collaboration and comfort level with teams, and posttest process variables as described above are understandable. These results indicate that previously held views are important in a face-to-face situation but are not a distraction in the distance environment. This is consistent with Johnassen (1995) who supported the use of technology to facilitate more meaningful learning.

It appears that background characteristics have no bearing on posttest results. Thus the evidence indicates that the difference in treatments is the overriding reason for the perceptions reported. In particular, we conclude that computer conferencing is a preferred means of communication in problem solving situations. We agree with researchers such as Alexander and Murphy (1994), and Wagner and McCombs (1995) who believe that distance education provides a natural forum for learner centered principles. Outcomes from distance learning will weigh heavily upon the techniques that support it.

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Neptune: Next Generation Web BBS

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Abstract: Classical Internet services are too fragmentary and lack of integration. Two technologies has tried to remedy this situation, but the WWW performs poorly in a certain application domains, while the often disregarded BBS is too dumb in content presentation. Therefore we propose a new system, the *Neptune* Web BBS, trying to get the best of both without their defects. Users can access a full-featured Neptune system in three ways. Among them, the Neptune mode outperforms the Telnet and the HTTP modes, and acts as a container over a variety of existing BBS protocols. In addition, the Neptune takes advantage of diverse presentation capability of WWW clients, portability and ubiquity of Java, and the combinational power of both. Key design issues and future directions are also discussed in this paper.

1. Introduction

1.1 Classical Internet Services

With the advances of the Internet, various facilities have been devised for computer-mediated communication [Fellers et al. 1995]. For example, we have electronic mail (e-mail), mailing lists, and Usenet for asynchronous interpersonal and group communication. As for synchronous communication, we have Internet Relay Chat (IRC) and various teleconferencing facilities. In addition, various information-sharing services are also available: huge collections of Frequently Asked Questions (FAQ) documents, Gopher, WAIS, and File Transfer Protocol (FTP) services. Moreover, the WWW opens yet another dimension of information retrieval and representation.

These Internet services are too fragmentary, however. Fragmentary services require diverse installation and configuration of servers, and make some trouble for server administrators (but it is the why such qualified staff are paid for). End users care nothing about it; what they cannot tolerate is the need to install and configure diverse special-purpose client software, to get familiar with them, and to develop a better skill in coordinatng them. For example, what if Alice wants to talk to someone that is responding her Usenet article? What if Bob wants to read the FAQ while reading the comp.lang.c++ newsgroup?

The WWW tries to integrate these services, though not so successful for several reasons. First, the Hypertext Transfer Protocol (HTTP) does not embrace entirely their functionalities. Second, software vendors do not integrate all of them seamlessly. A vendor may, for example, sell a suite of "integrated" WWW packages. However, the WWW browser (e.g., Microsoft Internet Explorer 4.0 and Opera 3.0) cannot read MIME documents, the e-mail and news reader cannot display HTML articles exactly as should be, and a parasitic Java applet cannot reuse WWW browser's Secure Sockets Layer (SSL) features (e.g., no *java.net.HttpsURLConnection* or *java.net.SSLSocket* available). Third, vendors do not follow official or de facto Internet standards. For example, no suite of WWW packages adopted IRC (defined in RFC 1459) and Finger (defined in RFC 1288) protocols for teleconferencing and user information; instead, proprietary infrastructures were devised again and again without obvious reasons.

1.2 BBS: the Disregarded

The bulletin board system (BBS), though disregarded by mainstream Internet community, does have most functional equivalents integrated seamlessly. Traditional FidoNet-style BBS's may be too closed, but the Taiwan Academic Network (TANet) BBS series [Su 1995] are much more interoperable with classical Internet services, and are more rigorous in system management. It is not uncommon to see over 500 people on-line simultaneously

in Taiwan's top BBS sites [Statistics], and a large proportion of Taiwan's Internet activities lie in or originate from the BBS community.

These BBS servers are typically accessed through the ubiquitous Telnet protocol, and consequently have several disadvantages. First, Telnet restricts clients to a "dumb" terminal (e.g., VT-100 or ANSI), thus forbids more sophisticated presentations. Second, Telnet consumes more server resources and network bandwidth than a specialized protocol. Third, the WWW has not been incorporated into the BBS yet. And fourth, BBS jobs are not distributed fairly between clients and servers.

We design a new system, the *Neptune* Web BBS, trying to get the best of both worlds. It, like the BBS, integrates various facilities in a highly interactive and user-friendly environment. It also, like the WWW, features hypermedia and other ongoing WWW technology. In the same time, the Neptune tries to eliminate defects from both. With it, fewer server resources and network bandwidth are consumed, and higher scalability is achieved.

2. Neptune: An Overview

A full-featured Neptune BBS can be accessed in three ways: by a Telnet client, by a raw WWW client, and by a Neptune-enabled WWW client (a Neptune client, for short), as shown in [Fig. 1].

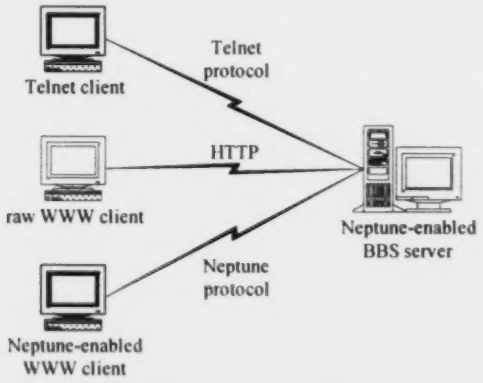

Figure 1: Three ways to access a Neptune BBS.

2.1 Telnet and HTTP Modes

Users can access a Neptune BBS by Telnet, as before. The old Telnet mode, in spite of many disadvantages mentioned previously [BBS: the Disregarded], remains the best choice for users that cannot afford a WWW client. Moreover, people unwilling to change their habits may stick to it.

Equipped with a WWW client, users enjoy more benefits brought by the HTTP mode:

- With HTML, XML, and style sheets (e.g., CSS2 [Bos et al. 1998]), users can customize more visual effects of articles.
- With hyperlinks, cross references among articles are more sophisticated and elegant than those found in traditional BBS and Usenet services.
- By designating each article's "message ID" as an URL's "search part" [Lee 1994], the article becomes globally and uniquely identifiable on the Web.
- With server-side plug-ins (detailed in [Server Technology]), the BBS server provides full transparency between on-line and archived (usually compressed) articles, and mimics the effect of persistent URLs.

In this mode, however, computation is biased toward the burdensome server. Second, HTTP/1.1 persistent connections [Fielding et al. 1997] are not implemented well in current WWW software. Third, HTTP/1.1 is still unsuitable for highly interactive applications due to its stateless nature, and the cookie mechanism [Kristol & Montulli 1997] helps little with this intrinsic weakness. And fourth, user interface in this mode still falls far behind that in traditional BBS and news clients. Therefore, it is recommended for discontinuous and casual reading of articles, or for limited client resources that cannot afford the Neptune access mode.

BEST COPY AVAILABLE

2.2 Neptune Mode

The Neptune mode combines both highly interactive user experience in the Telnet mode and media-rich capability in the HTTP mode. Equipped with embedded computational components and carefully crafted protocols, this mode has additional benefits:

- Computation is distributed more balanced among servers and clients.
- Embedded components on the client side will pre-process documents. Therefore users can still see documents even if their WWW clients do not recognize this document type (e.g., MIME and MHTML [Palme & Hopmann 1997]), without bothering to install platform-specific plug-ins or helper applications themselves.
- Sophisticated user interface is possible.
- When the Neptune client goes offline, it degrades automatically to the HTTP mode, and hyperlinks within opened or filed documents remain effective through carefully designed scripts (detailed in [Client Technology]).

3. The Protocol

Obviously, the first two access modes use traditional Telnet and HTTP protocols, respectively. We discuss only the Neptune mode here.

A connection-oriented, stateful protocol is needed to gain better performance for continuous interaction (e.g., on-line chat or noncasual reading of articles). We consider two types of application-level protocols: traditional character-oriented protocols, and new object-oriented protocols.

Character-oriented protocols transmit data as streams of bytes encoded into human-readable characters, and are classical paradigm in TCP/IP protocol suite. Several experimental BBS protocols fall into this category, e.g., PowerBBS, the Formosa BBS [Lin 1997], the BBSTP [Lin & Shen 1996], and still others based on the BBSTP. Though none had considered multimedia capabilities yet, they can be adapted to satisfy Neptune's needs.

On the other hand, object-oriented protocols transmit data as streams of objects. Extension is simpler here since messages and operations are encapsulated as self-contained distributed objects. However, both clients and servers are required to agree on a common object infrastructure, such as CORBA, Java (using remote method invocation, abbr. RMI [Sun 1997a], and object serialization facilities), and possibly, DCOM.

To accommodate a variety of BBS protocols (hereafter, *sub-protocols*), we define the Neptune as a container protocol, i.e., it defines only a standard interface between the Neptune core system and other sub-protocols. When a Neptune server receives a connection request, it responses as follows, specified in ABNF notation [Crocker & Overell 1997]:

```
first-response  =  status-line
                   *prot-list        ; sub-protocols accepted by the BBS server
                   "." CRLF          ; end of the text
                   ; similar to NNTP [Kantor & Lapsley 1986] and BBSTP protocols
status-line     =  status-code SP text CRLF
prot-list       =  sub-protocol "/" version SP flag [SP params] CRLF
status-code     =  DIGIT DIGIT DIGIT
                   ; follows NNTP and BBSTP conventions
sub-protocol    =  ALPHA *(ALPHA / DIGIT / "-")      ; sub-protocol name
version         =  1*DIGIT "." 1*DIGIT
                   ; follows HTTP versioning principles [Fielding et al. 1997][Mongul et al. 1997]
flag            =  ("C" / "c")       ; "C"ontinue this connection channel
                   / ("T" / "t")     ; "T"urn to another connection channel
params          =  text              ; protocol-dependent parameters
text            =  1*(WSP / VCHAR)
```

The server lists a number of sub-protocols it provides. If a Neptune client chooses a sub-protocol (say, *X*) whose connection flag is "C", it continues operations on the same connection channel. Otherwise, if the flag is "T", as often occurs when *X* is an object-oriented protocol that requires special client and server stubs, the Neptune client initiates (with tailing protocol-dependent parameters) another channel and then try to bind to remote objects desired.

To fully unveil the power of Neptune, minor extension to existing sub-protocols is advised. Take the BBSTP for example. To support user-customizable HTML style sheets, a new parameter *css* can be added into *FILE* and *PUT* command verbs. In addition, to support both HTTP and Neptune modes gracefully (see examples in [Client Technology]), yet another parameter *htmlhead* is introduced to the *FILE* command, and a new article header field *X-WWWorigin* is introduced.

Moreover, to make the client truly extensible and to provide better separation of mechanism from policy, a set of standard client interfaces are also required between the core Neptune and plug-in modules for various sub-protocols. We are working on defining such interfaces.

4. Design Issues

4.1 Core Technology: Java

BBS's success results partially from its ubiquitous clients (i.e., the Telnet), from minimal client installation, and from its ease of use; the WWW, alike. To retain the same portability and ubiquity in fewer efforts as possible, we choose the Java technology to implement client-side embedded computational components.

Java is portable not only at source code level but also at binary level, with the help of bytecodes. It is relatively ubiquitous with the help of a layer of Java virtual machine. In addition, Java applets are downloaded automatically and configure themselves accordingly when the Web page they parasitize is downloaded, and thus minimize software installation and future upgrades.

The use of Java, especially Java applets, also takes advantages of ongoing WWW technology intrinsic in prevailing WWW clients. A Java applet can communicate with its parasitized WWW client (hereafter, the applet's *parasitized host*, or *host* for short) via standard *java.applet.AppletContext* interface, and therefore reuse many functionalities. Ideally, an applet could use whatever interface its host exposes; the more the host exposes, the more degree of functional reuse is achieved. (In contrast, no general interprocess communication facility exists for Java applications to interface with platform-native applications such as WWW clients. Therefore we adopt the Java applets approach instead of Java applications.)

An applet lives in a sandbox provided by its host; secure, but severely confined. What is worse, few WWW clients allow developers to override (by standard *java.lang.SecurityManager* class) or allow end users to relax a certain restrictions on their behalves when necessary. Consequently, some Java applets in Neptune system are digitally signed (a feature introduced in Java 1.1) to get around some annoying restrictions [Sun 1997b].

In summary, we adopt the Java technology for its portability and ubiquity; Java applets for minimal installation and better interfacing with WWW clients, and signed applets for relatively unrestricted privilege. Other technologies can be incorporated in the future if adequate.

4.2 Server Technology

Traditional BBS is accessed by Telnet, and normally runs a generic Telnet daemon and a special login shell for BBS sessions. To interoperate with classical Internet services, it may also run SMTP and POP3 daemons for e-mails, a Finger daemon for user status information, and a NNTP daemon for article exchanges. These daemons are so typical that system administrators should have no difficulty managing them.

To support the HTTP mode, the BBS server usually runs an HTTP daemon, and uses server-side plug-ins (e.g., CGI programs, FastCGI programs, ISAPI programs, compiled modules, scripts, and servlets) as a gateway to check users' identity and then to respond accordingly. The use of such plug-ins also hide from users details of article storage and processing.

To support the Neptune mode, the BBS server has more jobs to do. It must, obviously, support one or more native sub-protocols (generally speaking, one is quite enough). It also runs an HTTP daemon through which WWW clients can download linked style sheets and scripts files (see examples in [Client Technology]), as well as Java applets (in signed JAR format). Moreover, if an object-oriented sub-protocol is used, an object infrastructure is also required. For example, to transmit a CORBA object across network, the server must equip itself with a CORBA ORB; likewise, to use Java RMI, a Java virtual or native machine is necessary.

A final note: employment of these technologies depends on resources available, service policies, and administration expertise. Features can be employed incrementally when needed.

4.3 Client Technology

Obviously, the first two access modes use traditional Telnet and WWW clients, respectively. We focus on the Neptune mode here. .

A Neptune client uses Java applets in many ways: to implement Neptune protocols, to dynamically load and invoke sub-protocol-dependent applet modules, to do I/O and cache management, to do session management, to pre-process documents, to interface with WWW clients, and to provide a sophisticated user interface. We discuss only document pre-process here since it is the trickiest part.

Before a document (fetched from the BBS server) is fed to the WWW client (by Java's *java.applet.AppletContext.showDocument* method) to show up, it has to be pre-processed for several reasons. First, some types of MIME documents cannot be recognized directly by WWW clients, and have to be transformed in advance. Second, even if the WWW client recognizes all possible types, it may not recognize some header fields specific to the Neptune system. Third, the WWW client may not recognize ANSI color codes common in plain-text BBS articles. Fourth, plain-text documents do not have in mind the concept of style sheets, and forbid users to customize presentation.

In theory both clients and servers can pre-process documents. However, we prefer documents (stored on the server) to remain as closer as possible to their original, untransformed forms for 2 reasons. First, for the original message digest (hashed from the document body and its author's digital signature) to remain valid, unnecessary transformation on documents is discouraged. Second, to facilitate interoperability with other non-Neptune BBS and Usenet, the server had better publish untransformed documents. Therefore, we designate the client instead of the server to do the pre-process task.

When the signed applet obtains a document from the server, it injects some HTML (or XML) and scripting codes into the document as follows:

```
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.0//EN">
<html><head><title>Sample Article of Neptune System</title>
  <!-- below: based on what obtained by BBSTP "FILE htmlhead" command -->
  <meta   http-equiv="Content-Style-Type"      content="text/css">
  <meta   http-equiv="Content-Script-Type"     content="text/javascript">
  <base   href= entry point to fetch articles from the server >
  <link   rel=stylesheet href= entry point to fetch this user's CSS file from the server >
  <script defer src= entry point to fetch the global scripts > </script>
  <script defer>
  <!--
   // initialize global variables declared in the global scripts
   Message_Id       = "X-Filename" of this article (local to this BBS) ;
   WWW_Origin       = "X-WWWorigin" of this article (unmodified across all BBS's) ;
   init( );
  // -->
  </script>
  <!-- above: based on what obtained by BBSTP "FILE htmlhead" command -->
</head><body>
<p code=header> <!-- generated from document headers -->
<ul>
  <li>From:  william@cis_nctu (Nickname)
  <li>Board:  WWW
  <li>Origin: <a href="http://bbs.cis.nctu.edu.tw">NCTU_CIS BBS</a>
  <li>Message ID: <script>bbs_msgid( );</script>
</ul>
<p code=quote>
  <span class=author>In response to helios@cis_nctu:</span> <br>
  quoted paragraphs
</p>
<p>I suggest that you read an
<a href="?anothermessageid"  onClick="bbs_read(this)" >article</a>
posted at the same board a week ago.
</body></html>
```


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With the help of highlighted portions shown above, style sheets can be made effect on per-user basis, and navigation can also be intercepted by the Neptune applets.

For convenience, some scripts common to all documents and users are extracted into a separate script file as follows:

```
//═══════════ Global scripts for Neptune BBS ═══════════//
// script variables
var /* string */ BBS_Applet_Name = "BBSmain";  // BBS configurable
var /* applet */ BBS_Applet = null;

// article header mappings; to be set as articles downloaded
var /* string */ Message_Id = null;            // X-Filename: local to this BBS
var /* string */ WWW_Origin = null;           // X-WWWorigin: unmodified across all BBS's

/* other functions, such as init( ), bbs_msgid( ), bbs_read( ) */
```

With the elaborate scripts, even if the Neptune client goes offline, hyperlinks within opened or filed documents remain effective by degrading automatically from the Neptune mode to the HTTP mode. Moreover, link integrity is also maintained even if the articles are fed to other Neptune servers. Thus, semi-persistent URLs for BBS articles are achieved in the Neptune environment.

5. Concluding Remarks

We have developed a new Web BBS: Neptune. It gets the best of both BBS and WWW worlds and is free from their defects. It also provides additional benefits not available before. Both servers and clients may choose among 3 access modes according to their own computing resources, habits, and service policies.

There remain many things to do. First, we need a better editor applet to hide markup and script details from end users. Second, administrators need better facilities to manage and extend their BBS sites. Third, we plan to refine the BBSTP and, in the same time, to extract common functionalities out of the core Neptune and a variety of sub-protocols. In this way we may define a standard interface for applets to conform to. And finally, server scalability and security are also critical issues in such an open internetworking environment.

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Composers Experimental Online Suite (ComeXos)

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Abstract: Network technology helps us to share our resources and Internet is a good example to show how we benefit from this invention. ComeXos is a on-going web-based research providing a forum for people to realize their musical ideas, to share their creation and to express their opinions on each other's works. The aim of this research is to investigate if the community and our business partner can be benefited from the collaboration based on sharing of the technology.

1. Introduction

Although the cost of the computers is believed to be halved every 1.5 year based on the Moore's Law, the use of computer can be still very costly. As software nowadays constantly crave for more memory (RAM) and demand faster computing processor (CPU), if one wants to keep up with the technology, one has to constantly upgrade their equipment.

Music application for creating digital audio can be more costly as often these application are required to run on additional hardware such as sound card with digital signal processors (DSP). That would be impractical to expect schools or even universities to upgrade their equipment so often in order to match the software hardware technology development. This research would like to investigate the possibility of centralizing both software and hardware resources to be used via Composers' Experimental Online Suite (ComeXos) and its impact.

2. ComeXos

The Composers' Experimental Online Suite (ComeXos) is currently being developed in the Music Department of University of Salford as one of the projects in GEMISIS 2000 - a European Union-funded Internet research initiative. The emphasis of GEMISIS 2000 is to use the networking technology to serve the community and to regenerate the economy in the north-west region of England.

ComeXos is a music service which the users can access via the Internet. ComeXos consists of a service in three different areas: an audio sample-processing interface, a sample archive and a discussion forum which aims to provide a space for users to develop their musical ideas, to share their creations and to express their opinions of each other's works.

The Internet has been chosen as the medium for ComeXos as it provides a neutral, operating system-independent platform for computers of various types (such as IBM-compatible PC, Macintosh and UNIX) to gain the same kind of access - retrieving the same information and sharing this information. As long as the user has an Internet connection and a standard web browser, there should be virtually no difference in accessing ComeXos using any computer, anywhere in the world.

ComeXos is currently hosted on an Silicon Graphics Challenge S server and the Composers' Desktop Project (CDP) is chosen to be the commercial sound manipulation tool online. In its early phase of development, access is limited to internal.

3. Objectives

The research aims to test the possibility of sharing service, ideas, skills and products on music via the Internet.

1. The focus of the research is to find out if the sharing of the use of the audio manipulating tool CDP on the Internet using the common gateway interface (CGI) is feasible or not and if it would assist composers to create computer music, in this stage audio samples, more economically and efficiently.

2. To investigate the advantages and disadvantages of the sharing of resources such as music applications and hardware via the Internet.

3. To see if services like ComeXos would provide a greater opportunity for the public to use a greater variety of tools in creating music without spending huge sum of money in purchasing different software and hardware.

4. To evaluate the current music applications of similar type found on the Internet and to investigate the possibility of transferring the same ideas onto different music applications.

5. To research the impact concerning the promotion of CDP. To see if, by sharing the music applications on the Internet would help to introduce the application to a wider range of users, and to arouse people's interest in the application, or even purchase their own copy for home use. The results could be vital for commercial application.

6. To investigate if students in schools would become potential clients to purchase CDP if they were given to use the software in schools. (CDP may become their chosen professional tools in music owing to the familarity with the program)

7. To see if creative people would be spotted by agents in the music industry through the forum provided.

Acknowledgements

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Web and Database Interconnection Tool – SQL2Web

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Abstract: As increasing the demand of applications on the World Wide Web, it is required a tool to develop easily web applications using database. With such a current trend as changing Windows-based application to web-based, KT needed such a tool. With the reason, we developed the tool SQL2Web providing a useful way to develop web applications to support database interconnection..

1. Introduction

As increasing the demand of applications on the World Wide Web, it is required a tool to develop easily web applications using database. With such a current trend as changing Windows-based application to web-based, KT needed such a tool. With the reason, we developed the tool SQL2Web providing a useful way to develop web applications to support database interconnection. SQL2Web uses metafile, so called Qfile, including HTML tags and SQL statements. SQL2Web executes the SQL statement and prints out the result with HTML document format. Therefore, it has merit that we don't need to modify CGI program when users ask alter the appearance of web page. We can get it from modifying only the Qfile.

SQL2Web is composed of two parts. One is kernel that interconnects web server with database, and the other is web-based tool for a developer. The kernel parses the Qfile and generates SQL statements with CGI parameters, and then the kernel shows the result with HTML document format to the user. The web-based GUI tool for a developer is composed for easily managing Qfile, so that a developer may develop web application using database in web environment. [Fig. 1] shows the processing diagram of SQL2Web. Currently SQL2Web can be used only for ORACLE RDBMS, but it will support for mSQL(mini-SQL: Hughes Technologies) in future.

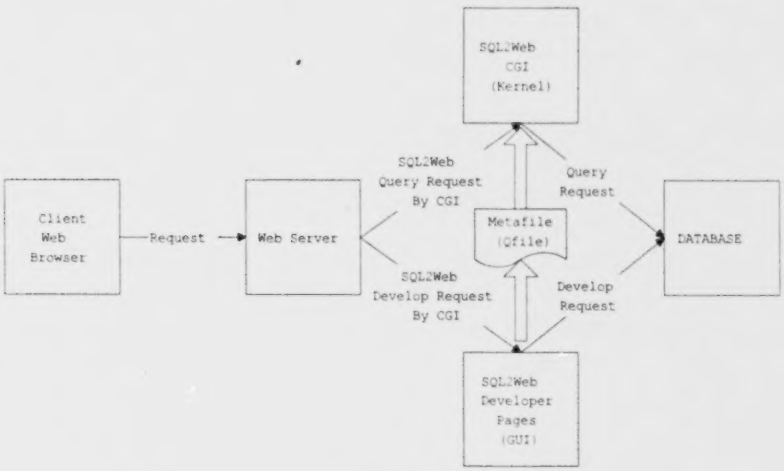

Figure 1: The structure of SQL2Web processing flow

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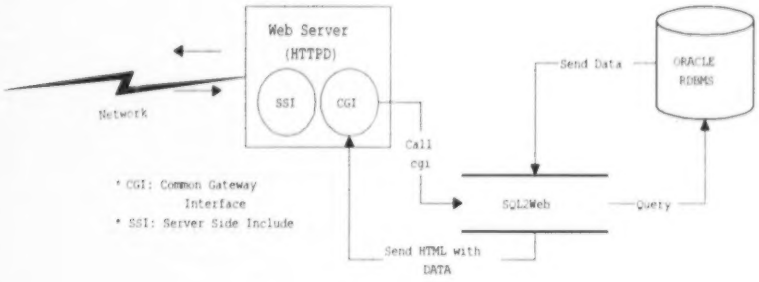
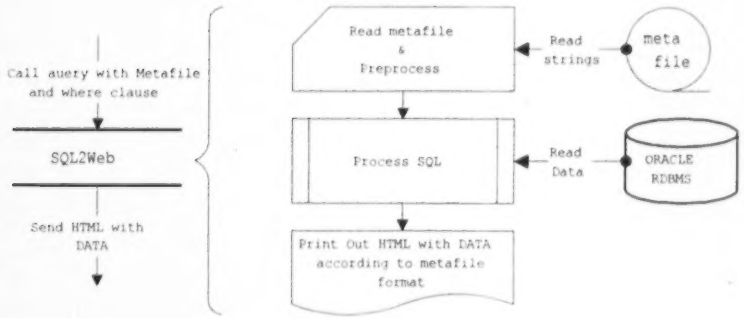
2. SQL2Web Kernel

The aim of SQL2Web kernel is to parse the Qfile and process SQL queries. The [Fig. 2] shows the processing diagram of the kernel. First web server receives a request of web page from a user. The web server calls SQL2Web kernel to process the request of user. And then the kernel parses entries on user's request and the relevant Qfile. After connecting to database, kernel selects the data, and then sends the result with appropriate HTML document format specified in Qfile to user. Therefore, there is merit that we can manage the appearance of web page by managing only Qfile. Moreover, when the developer uses the SQL2Web developer tool showed on the next section, it is very easy to manage the web pages because it provides web -based GUI environment.



(a) The interconnection of web and database



(b) The kernel uses the Qfile(metafile)

Figure 2: The diagram of SQL2Web kernel processing

2.1 Qfile Format

Qfile is composed of three parts. The first is parameter definition part that defines the parameters used in SQL2Web kernel. The examples of those parameters are such as "NEXT_LIST_MARK", "CONNECT", "SQL" and so on. The second is HTML definition part. This part is divided into two, one is HEADER and the other is FOOT. HEADER is to decorate the front of the web page by using HTML before the result of query. FOOT is to decorate the end of the web page after printing out the result of query by using HTML. The third is BODY part that prints out the result data of querying database. And in this part, HTML tags can be used for decorating the result in various forms.

2.2 SQL2Web Kernel : CGI

SQL2Web kernel is composed of three cgi programs. One is s2w_q.cgi that works to print out the selected lists from

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database to user. Another is s2w_i.cgi that works to update the content on database or insert new content into database. The other is s2w_d.cgi that works to delete the record selected by user on database.

3. SQL2Web Developer Tool

The aim of SWL2Web developer tool is for help developers to develop web application with web-based tool in GUI environment, developers can manage Qfile in an easy way. That is, this tool has a role in creating, deleting or updating Qfile used in the process of SQL2Web kernel.

SQL2Web developer tool has three working steps. The first step is to register the project name and URL at which the service starts. The developer can manage Qfiles with this project name later on. The second step is to create the table in database. This step is also provided by this tool in GUI environment. The third stpe is to decorate the web page using the HTML tags and describe the SQL statement in Qfile in as shown on [Fig. 3].

After all steps, the Qfiles and other kernel files of URL directory appointed by a developer in the first step are created.

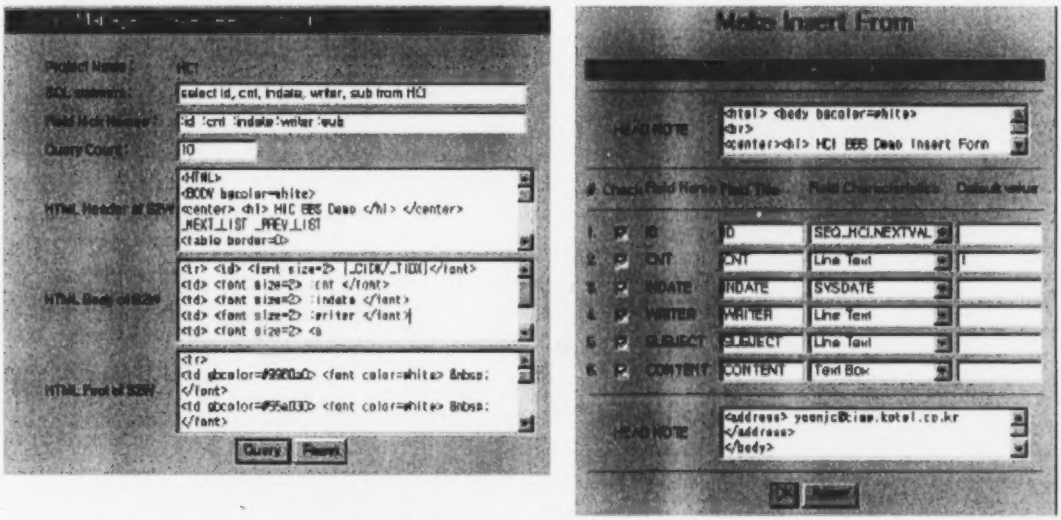

Figure 3: SQL2Web developer tool: Make Qfile forms

4. Conclusion

SQL2Web is an interconnection tool that may be useful when the developer wants the web pages interconnecting web with database. It is more useful especially, when manager has to treat lots of web pages. SQL2Web uses the Qfile (metafile) that contains HTML tags and SQL statement for query database. SQL2Web parses the Qfile and processes query, and then it makes HTML document as a result of user request. SQL2Web can also manage Qfile in web-based GUI environment by using SQL2Web developer tool. Currently we developed SQL2Web only for ORACLE RDBMS, we will continuously develop it to support mSQL(mini-SQL: Hughes Technologies) Database later.

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Polaris: Using HTML Clients and ActiveX Controls to Design an Online Library Catalog

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Abstract: In Spring 1998, Gaylord Information Systems (GIS) released its third generation library management system—Polaris. Polaris is a client/server system, running under Windows NT, that uses a Windows interface for all library staff functions, including cataloging and circulation. The public interface, used for searching the library's collections and other Z39.50-compatible databases, is a web browser.

While any HTML client can access the Polaris online library catalog, GIS developers have incorporated ActiveX Controls into Microsoft Internet Explorer so that the browser looks and functions much like a Windows graphical interface. This approach, unique in the library automation industry, ensures the initial screen does not scroll or page—the user is always given a clear context for the search. It also allows support for tools not normally found in public access software, such as a spell checker, a thesaurus, and a dictionary. GIS developers have also incorporated ActiveX Controls into the Polaris children's interface.

The Florida High School – Any time, any place, any path, any pace

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The advent of the Internet environment brings new possibilities for joining the best of technology with best teaching practices. The Florida High School is a joint project of Florida State Board of Education, Orange County, and Alachua County public schools. The core courses of Algebra 1, Chemistry, American Government, and Economics as well as the elective courses of Basic, C++, Pascal and Web Design previewed in January 1998. Core courses will continue to be developed along with appropriate electives until a complete high school online is a reality by the year 2001. Support services will be designed as a student development plan to include academic achievement, personal and social development, and career education.

Although the project is funded primarily through the Department of Education, several partners are assisting the school in its efforts. For example, the IBM Corporation has offered critical support through the IBM product Lotus Notes as well as a teaching platform called LearningSpace in which the teachers design and deliver instruction.

Netcourses have a number of advantages compared to traditional courses. Course curriculum is enhanced through the use of the Internet which provides web pages and expert mentors from all over the globe. In this new online environment students are active learners, interacting with the instructor as well as other classmates via e-mail and the web. The Florida High School offers a rich learning environment, which links the best in technology with instructional excellence.

DISTANCE EDUCATION

I. The Florida High School
   Any time, any place, any path, any pace

II. Why ?
   Choice
   Flexibility
   Home - School
   Hospital Homebound
   Personal Preference
   Linking Cultures
   Enhancement
   TIME !!!

III. Background
   Web School
   An Initiative of Alachua and Orange Counties and the FDOE
   For the Benefit of ALL Students and Teachers in Florida
   Collaborative Effort

IV. Curriculum
   Integration of courses
   Comparison to traditional courses
   Spiraling Curriculum
   Variable exit points
   Dual enrollment
   Support Services
   Validation Process

V. Instruction
   Learner Centered
   Active student participation
   Research Oriented
   Technology as a learning tool

VI. Assessment
   Performance based

VII.Organizational Structure

VIII. Alternative Funding Model

IX. Partnership with Industry
   IBM
   World Book Encyclopedia
   Many others

X. Looking at specific courses

XI. Successes and Student Reactions

Web-Based Performance Support Systems (WBPSS)

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Abstract: WBPSS is an interactive, Web-based learning environment that is designed to provide "just-in-time" training to students or employees at the time the information is most needed. For the past few years, WBPSS has become a hot topic for organizational development, human resources, and training development professionals. Because of the many advantages both research and applications of WBPSS are gaining momentum. This paper provides an overview of WBPSS. In addition, it discusses: the distinctive characteristics of the WBPSS; the advantages of WBPSS; different levels of complexity of WBPSS; and design and development guidelines for producing WBPSS.

1. Introduction

The importance of computers as a tool for learning and training is well established in both academic and commercial organizations. Indeed, computer-based training (CBT) is probably one of the most popular and effective ways of achieving individualized interactive instruction. However, a major limitation of CBT is the considerable lead-time involved in designing and producing the instructional software that is needed in order to meet perceived training needs. Another limitation is the large amount of time and fiscal resources required to modify, update, and maintain traditional CBT systems [Barker & Banerji 1993].

One recent approach to overcoming this limitation is through the use of an Electronic Performance Support System (EPSS). An EPSS is an interactive learning environment that is designed to provide "just-in-time" training to students or employees at the time the information is most needed. In its simplest form, it can be thought of as an electronic version of the user manual. In its most advanced form, a performance support system can be thought of as an electronic mentor. The system can be designed to diagnose the performance problem, determine the user's skill level in solving the problem, and immediately provide the information specifically needed by the user. The information can be in the form of text, audio, graphics, images, video or animation.

2. WBPSS

Performance support augments traditional training by providing on-going access to up-to-date information. The system is most effective when part of an integrated training program that combines classroom instruction, on-the-job apprenticeships and performance support. Performance support can reduce classroom instruction time by reducing the need for time-consuming retention and transfer activities. The information provided by the performance support system also greatly reduces the need for trainees to master large volumes of verbal information.

A well-designed and effective performance support system serves as collector, repository, and disseminator of organizational knowledge. Such a system allows experts within an organization to share their skills via video and other media to all members of the organization. In a similar manner, innovative techniques, short cuts, and "work around solutions" can be quickly recorded, disseminated, and incorporated into widespread practice.

The concept of electronic performance support systems is still relatively new. Gloria Gery's 1991 book Electronic Performance Support Systems: How and Why to Remake the Workplace Through the Strategic Application of Technology is viewed as the first major work on the subject. Within a few years, EPSS has become a hot topic for organizational development, human resources, and training development professionals. Because of their many advantages both research and applications of EPSS are gaining momentum. Paralleling the development of the EPSS concept has been the development of the World Wide Web. Improvements in internet-related hardware and software have now made it possible for the distribution of performance support systems via the Web. The merger of EPSS and the Web technologies has created the Web-Based Performance Support System (WBPSS).

In WBPSS, all diagnostic, interactive, informational, feedback, administrative, and media elements of the traditional performance support system are delivered to end users via the Web. The WBPSS can be served from a central location, either from a dedicated workstation or on a mainframe. Users access the performance support elements from a standard web browser. The centralized nature of the WBPSS and the multi-point accessibility of the system allow for efficient and flexible delivery and maintenance of the system.

3. Advantages of WBPSS

A WBPSS has the following advantages over traditional training methods:

- Reduced Need for Off-line Training
  WBPSS is technology facilitation for just-in-time training, learning, information, help and advice. It allows information to be delivered to the end user at the task site and in the time when the information is most needed.
- Multimedia Capabilities
  Recent developments in hardware and software allow efficient distribution of multimedia and interactive elements over the Web. The Web can deliver sound, text, images, video, animation, and interactive media at acceptable rates. Web-delivered multimedia elements can be accessed and employed at speeds approaching those of CD-ROM delivered elements.
- Diagnostic, User / Task-Specific Training
  A performance support system can diagnose the skill level of the user in relation to a specific performance task. Based upon the diagnostic process, the system can supply the information and media elements that are required to accomplish the task. A well-designed diagnostic process serves as a low-level expert system and allows for efficient management of information in the performance support system.
- Ease of System Maintenance
  Modifications or additions to a WBPSS are made only on the web server. Since the information resides in a central location, changes can be made easily by a limited support staff.
- Ease of Record Keeping and Data Collection
  The networked nature of a WBPSS allows for information to be collected from the users on the Web. The WBPSS could, for example, collect data related to commonly accessed information. An analysis of the data could reveal common problems and suggest useful topics for classroom training, either organization-wide or at a specific site. Data can also be collected in the form of user comments and questions either via electronic mail or interactive feedback forms built into the system.
- Reduced Continuing Costs for Materials and Distribution
  All of the information in the WBPSS is served from a central location. The centralized nature of the WBPSS eliminates the need to send software updates and manual corrections to all the user sites. The up-front cost of the WBPSS can be higher than traditional forms of information dissemination but the continuing costs are greatly reduced.
- Flexibility and Expandability

Depending on the requirements and specific user needs, WBPSS can be designed into different levels of interaction for assessing information. It is also a dynamic system that enables self-paced learning. Furthermore, it can be easily updated and expanded.

- Opportunity for Organizational Knowledge Building and Dissemination
  WBPSS is the electronic infrastructure that captures, stores, and distributes knowledge assets throughout an organization, to enable individuals to achieve required levels of performance in the fastest possible time and with the minimum of support from other people [Raybould 1995]. WBPSS also provides efficient and effective ways of enabling the knowledge and expertise to be shared within an organization.
- World-Wide Delivery
  No other medium can offer such broad, inexpensive delivery as the World Wide Web. WBPSS can be accessed by computers at any time, anywhere in the world without expensive printed training materials, CD-ROMs, or postal charges.
- Cross-Platform Delivery
  If WBPSS is properly developed on the Web, information such as text, graphics, audio, video files can be accessed by Macintosh, MS-Windows, UNIX, and other types of computers. This compatibility eliminates the need to develop two or more versions of the same program for different computer platforms.

4. Levels of Interaction of WBPSS

WBPSS can be divided into four levels for accessing information (see Figure 1). Each of these levels allows an increasingly complexity to take place. At the basic level, user simply selects a topic or task from the menu. The advanced level extends the basic diagnostic technique by integrating AI concepts, such as design elements of an Intelligent Tutoring System, into the advice and coaching provided by the software. At the advanced level, user performance can be compared to a knowledge base of expert performance to determine the appropriate level of advice to give, diagnose learning problems, and provide customized suggestions for training.

4	**Advanced Diagnostic Level**	• prescribes appropriate content • determines user's task competency • provides information on prerequisites
3	**Basic Diagnostic Level**	• determines nature of the performance problem • provides task specific information
2	**Advanced Menu Level**	• allows keyword searching and browsing • provides submenus on related topics
1	**Basic Menu Level**	• provides list of topics

Figure 1: Levels of interaction in a Web-based performance support system

5. Learning Hierarchy

Information in a WBPSS is organized in a series of hierarchical structures. These hierarchical structures represent all of the knowledge and skills, from the basic to most advanced, that make up a task. The hierarchies are developed from a procedural analysis for each task. The purpose of a procedural task analysis is to provide a clear picture of the super ordinate task, the subordinate tasks and prerequisite [Gagne et al. 1988].

A WBPSS allows users to access information at the most appropriate place in the learning hierarchy. Using the fictional task of replacing a broken widget as an example. In order to replace a broken widget, the user must master 3 subordinate tasks and 13 prerequisite skills. Traditional training modules begin with the most basic prerequisites and continue through the super ordinate task. This traditional structure is not the most efficient for a performance support environment. A WBPSS allows the user (or the system) to select only those tasks or skills essential at a particular time. For example, a user may not understand how to check the support rod. In a WBPSS, the user will be given only information that pertains to checking the support rod. This content-specific organization saves time and allows for on-demand access to information.

6. Design and Development Guidelines for WBPSS

While WBPSS systems are extremely powerful and effective, they must include highly effective individual components and a powerful, yet intuitive, human-computer interface. Although there are no "hard and fast" rules for designing a WBPSS system, the following general guidelines are provided for those involved in the design and development of an effective WBPSS.

6.1 Overall System Design

- A conceptual framework should be established as the basis for a WBPSS. The overall system must be user-designed that allows users to learn by doing.
- The overall system must be structured in a manner that allows many different ways to access the information [Milheim 1997].
- The system should be designed with the novice Web users in mind. It should consider the users' Internet connection methods.
- The system must be flexible and relatively easy to learn. They must be responsive to the demands of users in busy, changing workplace.
- The effective WBPSS must be designed well from both a functional perspective as well as a human interface perspective.
- The WBPSS system must be intelligent in responding to the specific needs of various users in reaction to varying job tasks and requirements.
- The content materials should be provided in small learning modules and be available to users at the moment of need to reduce the potential knowledge loss that may occur between the time of learning and the application of these new skills [Milheim 1997].
- The system should allow for continual and significant knowledge updates as the user becomes more and more experienced with various tasks and requirements [Milheim 1997].
- An effective WBPSS does not always need to dazzle eyes and ears with exotic sounds and graphics. Most importantly, the system must be designed to empower the user to perform with the shortest of possible learning curves [Stevens & Stevens 1995].

6.2 User Interface

- The interface should seamlessly connect the major components of the system to each other for ease of use and high accessibility [Milheim 1997].

- The interface should be simple, free of extraneous information, and free of unnecessary graphics, animations, and videos.
- The user interface, delivery strategy, and informational content each be designed around potential users and their likely interactions with the tasks to be supported [Laffey 1995].
- The WBPSS should provide a high degree of user control within the system that allows users to access information at the moment of need [Milheim 1997].
- The user interface is the key to successful WBPSS system. The user interface must be tested and revised throughout the development process.

6.3 Screen Design

- The screen architecture must be consistent throughout the WBPSS system.
- Screen objects must be placed in such a manner as to be easy to find and use.
- Cluttering the screen with objects makes it difficult for users to locate and focus attention on any one object [Stevens & Stevens 1995].

6.4 Navigation Design

- In addition to hypertext links for navigating through the system, other navigation features such as hierarchical menu structures, interactive system maps, and keyword searches should also be included in a WBPSS system to keep users from getting lost in the system and keep users focused on relevant information or tasks.
- A button bar with text and graphic buttons should be used for user navigation. Also, online help menu or wizard would be helpful for users who may need assistance.
- The inclusion of a contextual overview of the structure of a system would be helpful.

6.5 Testing and Evaluation

- After designing an interface, test the design to be certain that it is working as intended.
- A functional prototype should be built early in the design phase. A pilot testing should be conducted after a prototype of the system has gone through a number of revisions.
- In addition to alpha and field testing, continuous evaluation and revision on all the components within the WBPSS system are essential.
- The system should be tested in end user's environment.
- Case problems, test questions, and simulations can be used to provide the user with methods for determining whether certain knowledge or skills have been acquired [Puterbaugh 1990].
- Continuous improvement after the system has been disseminated into an actual work setting [Milheim 1997].

6.6 Web Design Guidelines

- Create descriptive titles and subtitles for each page.
- Design a WBPSS for different browsers on various platforms.
- Always test each page for errors and bad links.
- Use relative URLs for portability.
- Keep each Web page less than 100K for fast loading.
- Pages should not be longer than 4-5 screens..
- Provide a navigation bar on each page.
- Keep the number of graphics to a minimum.
- Reduce the color depth of image. Resolution and color depth affect download time.
- Rely on GIF format for simple, flat art or line drawings.

- Use JPEG format for photographs and other continuous tone images.
- Avoid using large graphic menus.
- Keep graphics and picture less than 400 pixels in width (about 2/3 of the average screen size).
- Limit the size of graphics files to 25-30K for fast loading.
- Use dark text on light background or light text on a dark background.
- Use audio and video only where appropriate.
- Limit the size of audio and video files.
- Store multimedia elements in standard formats.
- Include file size information in links.

7. Summary

WBPSS is a Web-based integrated environment that contains of a wide range of information, data, images, videos, tools, guidance, advice, and assessment and monitoring systems. For the past several years, WBPSS has shown significant potential for the improvement of user performance in wide variety of educational and corporate settings. The ultimate goal of WBPSS is to enable user to achieve required levels of performance in the fastest possible time and with a minimum of support and assistance from others.

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WebNet 98 Proceedings
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Dear WebNet 98 Program Chairs:

I am pleased to know that my proposal was selected to present at the WebNet 98 Conference of the WWW, Internet and Intranet in Orlando, Florida. Enclosed is a Transfer of Copyright Agreement form and a hard copy of my paper for the WebNet 1998 Proceedings. The electronic version of the paper is sent via e-mail on the same day as well. The title of my paper is "Web-Based Performance Support System (WBPSS) and the Session # is 325.

Thank you very much for your assistance. I am looking forward to presenting my paper in Orlando.

Sincerely,

Steve C. Yuen, Ph.D.
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A Web Interface to a Self-Study Collaborative System

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The system described in this poster/demo and outlined in [Fig. 1] provides an environment where students and learners can collaborate among each others in learning activities [Pinto et al. 97], through a popular and well known interface: the World Wide Web.

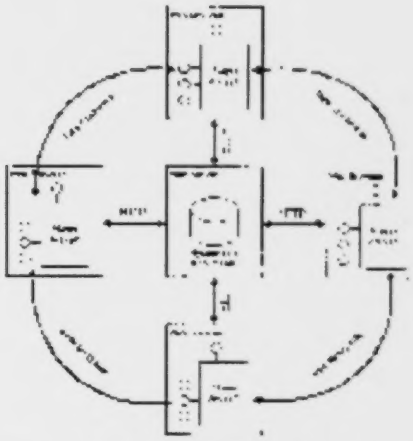

Figure 1: Self-Study Collaborative System

The system is based on by a Web Server that stores documents, used for the learning activities, and allows the access do these documents by means of common Web Browsers. These documents are hypermedia documents, produced with the authoring tool HDC (Hypermedia Documents Composer) [Martins et al. 98 & Pinto et al. 95], and aren't HTML. The system includes a component, the Player ActiveX, that allows their viewing and annotation after their download through the Web Browser. The Player ActiveX is in fact the hearth of the collaborative system. It can create or join a data conference between several Players and provide a synchronous environment where users can simultaneously view and annotate the same document. It allows two kinds of annotations: private and public. Only their author sees private annotations, public annotations are distributed through the data conference channel to all users and seen by all. This annotation system provides an effectively way on which the users can share and exchange comments and ideas over the same study-material.

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A Practical Approach to Intranet and Extranet Applications

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1. Presentation

Developing Intranet applications carries out new problems, which at present can't be worked out by traditional analysis and modelling instruments. Requests for platform-independence [NASA 95], that are necessary in order to reach Intranet goals, are hindered by proprietary technologies use.
To solve these problems, we are developing a model for Intranet networks and applications classification, and use it in our software production cycle. It is Intranet Application Model (IAM) [Intrasoft 98] and it allows us to evaluate how many Intranet applications or networks are close to ideal.
Considering the operations required by every group of users, we can separate applications in elementary logical parts, reaching in every part the highest independence from proprietary technologies.
This poster will show how to approach to Intranet applications problems, and practical samples will be lead .

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A Web-Based Individualized Adaptive Computer Aided Learning System

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Abstract: In order to develop a more effective CAL (*Computer Assisted Learning*) system suitable for the Internet environment, in this paper, first, we propose a new learning aid model called "*test□searching information by an adaptive knowledge-map□adaptive learning*", in which a user's study level is on-line diagnosed and, according to the result of diagnoses an adaptive knowledge-map guiding an adaptive learning is supplied to the user by a computer. Further, we describe a general-purpose system configuration that builds up such learning aid environment.

1. Introduction

Aiming at settling some problems of education fields is the starting point of developing educational systems. In order to achieve this, for a practical educational system used in the education field, it is essential to supervise the operation situation of the system and according to the feedback information modify the internal data of the system at any time, with participation of teachers in the education field. But, in many cases of applying the WWW to education fields, it seems that teachers have difficulty directly developing and managing WWW-based intelligent CAL (*Computer Aided Learning*) systems, because of the shortage of funds and teachers who are skilled in both AI and computer information technologies. For this situation, in this study we present a scheme for developing web-based individualized adaptive CAL systems, focusing on the problem-solving in representing and reusing teaching knowledge, as well as establishing easy-to-use interfaces that help teachers develop and manage intelligent educational systems.

This paper is organized as follows: first a new on-line learning aid environment suitable for the feature of the WWW is presented in section 2. We then explain the configuration of our system in section 3, which realizes such CAL environment proposed in section 2, finally the conclusion is given in section 4.

2. A New Learning Aid Model on the Web

The substantial feature of the WWW is that it is a distributed and open system. Because large quantities of information are distributed on the Web here and there, in the case of searching information using the WWW without a guide, it seems difficult for a user to grasp such things as what kinds of information are available, where is the necessary information and so on. For this reason, a user often has difficulty searching for necessary information. By using *knowledge-map* [Zhu el al. 97], a user can not only search out necessary information visually, but also understand the relationship of knowledge as well as master the method of sorting out knowledge from basic principles to practical application. Accordingly, we propose a new learning aid model called "*test□searching information by an adaptive knowledge-map□adaptive learning*" for establishing an on-line individualized adaptive learning aid environment on the Web. On the on-line learning aid environment, the process of learning aid between a computer teacher (server) and a user (client) can be described as follows. First, in order to diagnose a user's study level some test questions are sent to a user by server, and then the user gives his answer and sends it back to the server. Further, the server analyzes the user's test result and supplies the user with an adaptive guide expressed by an *adaptive knowledge-map* [Zhu el al. 98] that is just in line with the user's study level. According to the adaptive knowledge-map, the user can search out the necessary learning information visually (the related link buttons are set inside the knowledge-map) and make an adaptive learning sample objectively.

3. Configuration of System

In order to realize such learning aid environment proposed in section 2, we present here a *web-based individualized adaptive CAL System* based on case-based reasoning approach [Zhu el al. 98]. The configuration of the system is divided into server side and client side. On the server side, the component parts of the system include CBR processor, register, knowledge base and its manager, case base and its manager, publisher, as well as monitor. The function and outline of each part of the system are arranged as follows.

□ CBR Processor

The processes, such as calculating similarity degree between cases and retrieving case from case-base as well as controlling data transmission, and so on will be done by CBR processor. So it is called the *HEART*

of the system.

- Register

Through a register window, a teacher can register his teaching strategy into a knowledge base of the system by himself.

- Knowledge base and its manager

Storing and managing the teaching strategy from teachers. The teaching strategy is represented by a case, which consists of a knowledge pattern and a number of related knowledge units that form an adaptive knowledge map.

- Case base and its manager

By calculating the similarity degree between a test pattern (on-line test record) and a knowledge pattern beforehand stored in the knowledge base, the closest pattern is retrieved from knowledge case into case base as a successful case. At the same time, a HTML file of an adaptive knowledge, which matches the pattern said above, is auto-generated by publisher of the system, and its URL is also sent to the case base. The role of the case base and its manager is storing and managing the above data.

- Publisher

Creating HTML files of adaptive knowledge maps and their URLs on-line, which are in line with the study levels of users.

- Monitor

Through a monitor window feedback information, such as test patterns, referred knowledge patterns, similarity degree between a test pattern and a referred knowledge pattern, as well as accessed times for a case and so on, can be supervised. According to the feedback information a teacher can grasp the operation situation of the system and modify his teaching strategy at any time.

On the client side, the components of the system include applets plunged in Web pages and WWW browsers such as Netscape or Internet Explorer. For an on-line learning aid process, first, a student gives out his answers for test questions through an answer sheet that is made by an applet. When he clicks the *FINISH* button on the answer sheet, the test record (pattern) will be transmitted to the server by ORB (Object Request Broker), a transfer protocol. On the other hand, on the server side, by case-base reasoning, an adaptive knowledge-map, that just matches the test pattern, is retrieved from a case base and its URL is sent to the client. Through HTTP and the URL, the client can get an adaptive knowledge map, and with the help of its navigation guiding, a user can search out the necessary learning data in line with his study level quickly and objectively.

4. Conclusion

In this paper, we first proposed a new on-line learning aid environment called "test searching information by an adaptive knowledge-map adaptive learning", and then described the configuration of the system which builds up such environment. So far, the system has been actually developed on a UNIX system. The functions on theory design have been initially realized and a positive achievement has been evaluated. For future work, we plan to improve and complete the interface functions of the system towards a general-purpose tool of developing web-based individualized adaptive CAL systems.

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WWW-CALIST: A General Purpose Tool for Constructing Web-based Individual Adaptive CAL Systems

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It seems that a big problem in applying the WWW to education fields is that teachers have difficulty directly developing and managing a WWW-based intelligent CAL (*Computer Aided Learning*) system, because of the shortage of funds and teachers who are skilled in both AI and computer information technologies. Focusing on solving the problem, we have developed a general-purpose tool called *WWW-CALIST* (*WWW*-based *C*omputer *A*ided *L*earning *I*ndividual-adaptive *S*ystems *T*ool), which helps teachers build up a web-based individualized adaptive computer aided learning environment called "*test search information by an adaptive knowledge map Adaptive learning*".

The WWW-CALIST has some such functions and features as follows:

- Through a register window, a teacher can input his teaching strategies into a knowledge base easily. And *adaptive knowledge maps* guiding an adaptive learning can be created on-line by the system.
- Through a monitor window, a teacher can immediately supervise the operation situation of the system, and according to the feedback information modify his teaching strategies at any time.
- By using easy-to-use interfaces equipped with the tool, a teacher who knows only the HTML can develop and manage web-based individualized adaptive CAL systems for varied education domains.
- The tool is developed in JAVA and its upper exchanging language ORB, so it is OS independent.

Telematic Platform for Patient Oriented Services

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Abstract: *This paper describes in brief a basic framework for implementing a telematic-platform for patient oriented services. We first show the current situation in the medical field and work out the requirements for an integrating platform. Afterwards we introduce Active Node Technology (ANT), the technology the platform will be based on.*

Introduction

The always increasing life expectancy and the increasing number of long term and care patients has led to a dramatic explosion of costs. The goal of implementing a telematic-platform for patient oriented services is to increase the quality of health care while reducing the costs through an efficient employment of information and communication technology. A consortium in Germany headed by the Deutsche Luft- und Raumfahrt (DLR) is developing a system which will provide national access for all.

The basic element of the system will be an integrative, network based workflow system with a realtime database – the telematic-platform. The platform should provide a simple and easy to extend standard, bringing together all involved parties as there are patients and health care staff and other users, service provider or device manufacturer. This will set national and international standards and thus reduce the uncertainty for developers and service providers. Based on this platform, health services will be provided. Some examples of planned services are: monitoring of heart circulation patients at home (e. g. before and after an operation), communication services for care patients, integration of doctor's practices and emergency services, administration services, expert databases and more.

Patient data including medical as well as administrative information is stored at the moment at many different places on different systems. The doctor often lacks the results of previous examinations and thus repeats the examination or even more dangerous, does not make the right diagnosis. Using the platform, patient data will still be stored distributed physically. But it will be virtually available as a single, structured patient record. Data in such a complex system can be of various type. There can be simple textual information, multimedia documents as X-ray images or even realtime data like ECG or EEG records. For that reason a further requirement for the platform is to be open for current and future data standards.

On the other hand patient data may be very sensitive. Only authorized people may be allowed to get access. Sometimes even the patient himself may not be authorized to read his data (think of a critical illness of a psychological unstable person). Beyond the problematic of this in general, there is a strong request for security and confidentiality on the platform.

In the following section we will work out the requirements for a telematic-platform and show the improvements it can make over the current situation. After that we introduce Active Node Technology, a data and communication framework which serves as the basic technology for the platform.

Current Situation and Requirements for a Platform

Integration

At the moment in the medical sector there is a large number of incompatible platforms. This is due to the fact that existing systems are only designed for one local zone. (E.G. only for one specific Hospital) Further the aspect of data exchange has been treated to be unimportant or even has not been taken into account. Up to the last few years there were no adequate transport mediums available, but with the rapid growth of networks we now have the possibility to think about the integration of different systems.

Although sometimes a complete reengineering of such local systems will be necessary to get them fit into a national or international platform, the main goal of integration must be the preservation of investment. Therefore an integrative platform must be considered as a higher layer serving as an interpreter. Gateways allow to extend the framework and to 'plug in' existing or newly developed systems.

Existing systems are implemented not only for local use, but they are based on different platforms technically. Thus an

integrative layer should be platform independent. Java as a platform independent and worldwide accepted and widespread language will serve this requirements best. In addition Java allows both, to get the interface of the platform simple and easy to extend.
A simple interface is important to reduce development costs for system integration and to get accepted by the industry. Java is widespread, it has a simple language syntax and comes with a large library. Together with a simple interface definition this solves the conditions for an easy platform. Second, an easy extension of the platform is indispensable. We can not know yet which requirements future medical services will request. With Java we can use dynamic loading of classes, allowing simple integration of new modules.

Distributed System - Global View

It will not be possible to store and manage the huge amount of data the platform will have to handle centrally. Nevertheless, the user of the platform will want to get a global view on relevant data. In addition, not only data will be handled by the platform, also distributed services will be offered. And the user should get access nationwide or even worldwide.
To fulfill these requirements we use the concept of distributed server and clients but offer a global address space for all data and services. Think of this virtual address space as a large file-system, organized hierarchically. Navigating down the tree, the user will visit different spaces and servers transparently. Although the user connects to different machines and uses different services he has the imagination of serving one single space.
The users view of the medical framework depends on his current role, (doctor, stewardess in an emergency role, ...) on his current location and on his personal settings. Although the address space is global for each user it is not unique or static. Quite the reverse, each user gets an adapted view, fitting his requirements. This is a very important feature of the framework. Heaving only one static address space would very soon led to a lost of comprehensibility.
Additionally, clients and server in this framework get the same interface and can therefore interact with equal rights. A gateway or another software module written for a client can be used on a server as it is. On the platform, the borders between client and server become blurred and sometimes they will even change roles. Thus the platform is more a network of partners than of clients and server. This makes development and integration of new services an easy task.

Collaboration

Most current systems focus on the storage, processing and retrieval of data. A telematic-platform for patient oriented services must include collaboration. Collaboration not only as a support for communication like email or chat. Collaboration in this environment means possibilities to perform collaborative work on data. An example could be the "online specialist knowledge". A practical doctor who asks a X-ray specialist for his opinion on a distinct X-ray image. Or the request of one doctor on another to check his diagnosis, knowing that he is a specialist for that kind of illness.
A platform with collaboration features will better connect people, using knowledge more efficient and overcome the problems of geographically distant operating medical staff. Collaboration will strongly be used between care patients at home and the hospitals and e. g. between a flight attendant treating an emergency patient and a doctor on the earth. Such collaboration data might be ECG data to find out the danger of an emergency or to control the patient while he sleeps. Thus the support of collaboration is one very important requirement for the platform.

Multimedia

Even if you gain control of the problematic of data exchange between different systems there is a further problem: Current systems do not use the potential of multimedia data. Although some systems can handle specific data like ECG streams they are not able to link them together. And a complete patient record consists of all possible data types. To make a diagnosis, the doctor needs all the information of a patient, current and previous.
Thus an adequate platform must support all types of multimedia and real-time data. Not only known data formats must be include, the platform must be open to integrate data types and services not yet invented. A powerful concept is to use a self contained object oriented approach. Data, and means to handle that data (e.g. viewing or editing) are bundled and shipped together. Thus inventing new data types is very easy. As a technical solution for this approach we choose the usage of the programming language Java in combination with the Java-Beans Activation Framework of Sun Microsystems. We assume a rapid spreading of this technology and have therefore included the concept in the platform.

Structured Data

Patient data will become very extensive and many different people are interested in this data. To serve the needs of the user, the information will have to be structured effectively. Structuring has a number of aspects. A defined structure for patient records means to provide different views on the same data. So a doctor may view all the data of one examination or all data according to a special discipline like X-ray or eye diseases. A defined structure is necessary to make different patients data comparable either for expert systems or for statistical research.
But structuring cannot stop at the document level. The document itself will or must be structured. Concepts like HTML are not adequate since structural information and content are mixed in one document. The upcoming XML standard may be one solution to think about. At the moment one information management system fulfills most of the requirements: Hyperwave[Maurer 96]. It is object oriented and allows to create well structured information and to include multimedia.

Security

One of the most critical aspects for the acceptance of a telematic-platform for patient oriented services is security. It is no service of the platform it is a necessary condition. Security in this area covers two different aspects: restrained and controllable access to data and confidentiality.
It is obvious that patient data is very sensitive. Additionally access and management of data is restricted by law. Only authorized user should gain access to different types of data. But it is not that easy to determine who and when should get which access rights. Doctors, politicians, patient representational and different organizations will discuss the problematic possibly forever. In addition access rights are very often case sensitive, think of an emergency situation as an example.
A platform must include a security concept, including the use of smart cards, encryption, secure data transfer, dynamic user management and access logging. (With access logging each request for sensitive data is logged and the affected person gets periodically reports of all people which had access to the data. Thus access can be checked and if abused be punished by justice.)
The second aspect of security is confidentiality. If the patient record exists in written paper, the doctor can view the signature on the document and thus trust it. If stored electronically, the author of each document must be unequivocal acertainable. Therefore each document will have to be signed to guarantee that the document has not been changed by another person. At this place it should be mentioned that the term document is more complex than it seems. To get its correct meaning a single document often is based on a number of other documents. If one of the applied documents is removed or changed, the note or diagnosis may get meaningless or even wrong. This means that a platform will have to include versioning and signing of documents within their context. The problem of confidentiality is not treated in more detail in this document.

Roles

At last we want to describe another requirement for a telematic-platform. We mentioned above, that there are a large number of different people who will use the platform. And each of them will usually have more than one role in the system. A doctor will also be a patient, a flight attendant as normal user may sometimes be in the role of an emergency staff, a medical student may be interested in statistical data as well as having to treat some patients and will have night duty with responsibility for more patients than over the day for example.
This implies the requirement for an easy to manage, highly dynamically user management. It also has to provide the possibility to gain extra access rights without complicated administration. (e.g. in case of an emergency situation)
In addition the system must provide different views of the whole system depending on the current role the user is in. This includes data as well as services. An administrator of a health insurance company will need data like patient Id or cost of a stay in hospital but should never gain access on medical data while it may be vise a versa in the doctors view. Other possible views are anonymous statistical data for research or controlling a medicine. Another useful service may be an expert database which possibly automatically checks the patient data for conspicuous patterns.

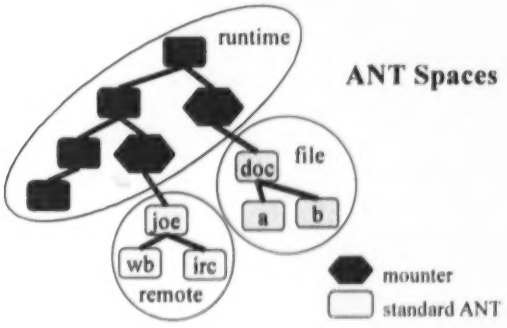
Active Node Technology (ANT)

The following chapter introduces ANT, the basic technology of the platform. ANT will fulfill some of the requirements worked out above, others will be reached by adding components to the ANT network, like Hyperwave server technology,

security and encryption modules, logging services and more. ANT is implemented in pure Java. ANT is therefore per definition platform independent. Loading of classes is done at runtime, thus dynamic extension is inherited from Java too.
Active Node Technology or short ANT is a technology to provide a virtual global space of interconnected active objects. The virtual address space describes the base idea of this technology. But only when considering the other constituting functions of ANT it reaches its full potential. The functions are: implicit structuring of objects, property support, asynchronous as well as synchronous communication, a specified service interface, included security mechanisms and not at least strict distinction between location/protocol and data (mime type).

Virtual Address Space

The virtual address space is much like a file system, especially like that one of UNIX. The addressing starts with one and only one single root object. All other objects are children of the root object or their children. So all objects in ANT constitute a single, hierarchical but virtual structure. The double dimension of the word virtual will be worked out later.



Since each object has a single position it can be assigned an unambiguous address. As an example, the address of the object 'joe' in the image above is `/tmp/coll/joe`. Each object can therefore be identified and found very easy. Looking at the tree structure of the object hierarchy it is obvious, why we choose an explorer, the ANTExplorer, as the basic tool for operating with ANTs. (Here and later ANT is used as a term for an object in the hierarchy. The term ANT is no accident. It should make clear, that we operate with interconnected and communicating, independent objects.)
The top of each virtual address space is formed by the so called runtime space. The ANT of this space only exists in memory. Subspaces of that may be objects at any location. There can be file ANTs, http ANTs, remote ANTs and more. Subspaces are generated by a mounter. The procedure to mount a subspace is similar to mounting in UNIX. There you first generate a directory (`mkdir`) and then you mount (`mount`) any device on it. Thus you can access the content of e. g. a CD-ROM as if it is a subdirectory of the mounting point. The picture above shows two spaces mounted, where `api` and `coll` are the mounters. The mounter is always part of the parent space.
Mounted spaces like the content of a Hyperwave server may not exist physically on the mounting Java Virtual Machine. Only the mounter really exists, the spanned subspace is provided by the mounter as a virtual subtree. But this is transparent to the user, all objects seem to be part of one large address space.
Spaces mounted in ANT are not only passive data like data on a file system or on a WWW server. You can also mount the ANT tree of another machine and thus get access to all objects mounted there. So if each server in a network mounts a number of other servers you will find the content of all of them by virtually navigating down only one single address space.
Beyond the mounting of data access protocols like ftp or file and mounting of other ANT trees, you can use the mounting facility to mount services. Thus a logging service or a telephone book service will be mounted the same way as structured data. The folders and subfolders will show a structured view of offered services. An electronic store thus can provide a view of all products structured by department and additionally by label. Selecting a product you will get all information you need about it and you will be able to buy it e.g. by usage of drag and drop, or any other simple interaction. If not needed, the mounter may even have no children just providing some services without the usage of structuring.

Structure modification

One fundamental function group of ANT is the structure modification operation. If you for instance want to move the file `a` into the remote machines folder `irc` you simply process the following instructions (simplified):

```
Ant a = new Ant ("/api/doc/a");
a.move("/tmp/coll/joe/irc");
```

Further, ANT has native support for creation, removal, copying, moving, linking and mounting. So the most important operations for e.g. publishing documents are built in functionality of ANT. Using the native ANT tool, the ANTExplorer, this operations are simply done with drag and drop or menu calls. Downloading of documents from any location using any protocol works in the same way.

Moving or copying of objects is very simple. Since objects in ANT are alive, they can move them self thus implementing agents. If they want to leave a secretary at the old place they simply create a link. Provided the access rights, objects can travel around gathering information and processing data.

Properties

All ANTs support properties, key – value pairs. You can perform all common operations on this properties. So you can modify access rights on a file system by changing properties or adding a second name for an object in Hyperwave. With the ANTExplorer you can modify properties by using a submenu of the context menu or the file menu.

Communication

ANTs have built in support for synchronous as well as asynchronous communication. In addition you can invoke any method on the destination object (if allowed). The mechanism is much like RMI[Sun Microsystems 97] but usage is easier. The ANTs thus provide all the means to simply set up collaboration services from simple chat mechanisms over workflow controlled collaborative work to collaborative work on shared data.

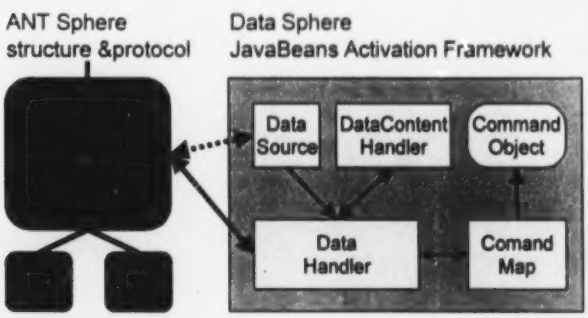
Services

Each ANT can define its own services. This may be simple services like providing a local print stream, more special services like property editors or even extended services like server administration, workflow management, user logon and management and more. Services may have a visualization, most times they will have one. With the ANTExplorer you will access services by first selecting the ant you want the service from and then selecting the appropriate submenu in the context menu or in the tools menu.

Providing services is a very powerful and simple means of ANT. To provide services you simply write a special mounter, e.g. a conference submission mounter. Once mounted, any user can navigate to your submission folder. There he will be presented some nice documents and in addition find all your services in the context menu of its ANTExplorer. Submission of a document is simply done with drag and drop or by providing an URL.

Data

One of the most important features of ANT is the separation of data on the first side and protocols and structure on the other side.



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The ANT sphere provides all the handling of different protocols. It is completely transparent for the user where the data comes from and which protocol is spoken. The ANT sphere provides a structure, the virtual address space. The data share is completely separated. It is based on the mime type of the data and is not interested in any protocol or structure. We use the JavaBeans Activation Framework[Calder 97] of Sun Microsystems (in short JAF). Using ANTs you simply say getData() setData() to access the data while data-handlers will do the work for you. So storing a file or publishing a document on a http server seems to be the same. And uploading files to a server is simply done with drag and drop in the ANTExplorer.
The JAF provides commands for each data type. Commands can be editors, viewer and more. To get a command for a distinct ANT you simply use the context menu of ANTExplorer or the file menu respectively.

Security

As mentioned above, security and confidentiality is fundamental for a telematic-platform for patient oriented services. ANT provides simple and transparent means to deal with this requirement. The first security mechanism concerns data transfer. Connections between different ANT systems are done via secure connections (e.g. SSL), thus providing security at the transportation layer.
The second mechanism uses a ticket validation system for checking and logging each request for secure data. Each time a user tries to access protected data, he is requested to provide a suitable ticket. This will be done by a ticket factory, a built in service of ANT. The ticket itself is a multiple encrypted piece of data, containing information like signer, date of issue, valid period, issuer and more. When creating a ticket the factory pops up a dialog to inform the user of the type of request he should sign and will possibly ask the user for an appropriate combination of login and password. When using smartcards the user will only have to agree the request by clicking ok. Each issue of tickets is logged at the issuing server, so supervision and later checks are possible.

Examples using ANT

Although invented as a concept for a telematic-platform for patient oriented services, the ANT concept is suitable for much more fields. Examples where we currently use ANT are Hyperwave server data visualization and navigation aids and server administration and publishing. The basic tool therefore is the mentioned ANTExplorer, so e.g. downloading of even multiple documents to the filesystem, or any other system, can be done by drag and drop.
Another example is a controlling tool for distributed organizations. Based on Hyperwave for storing data and providing the user management special CHRONOS ANTs provide services like creating a project plan, online recording of working time for each projects collaborator and tools to create reports and deviation analysis.

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